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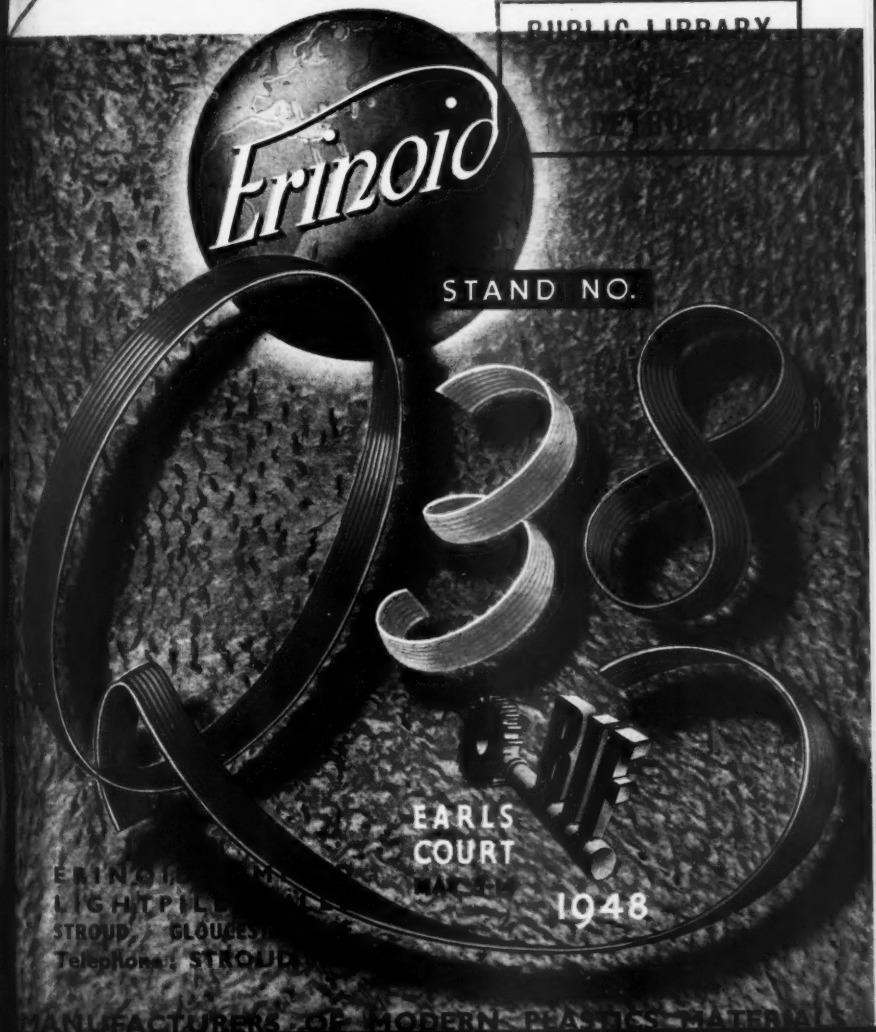

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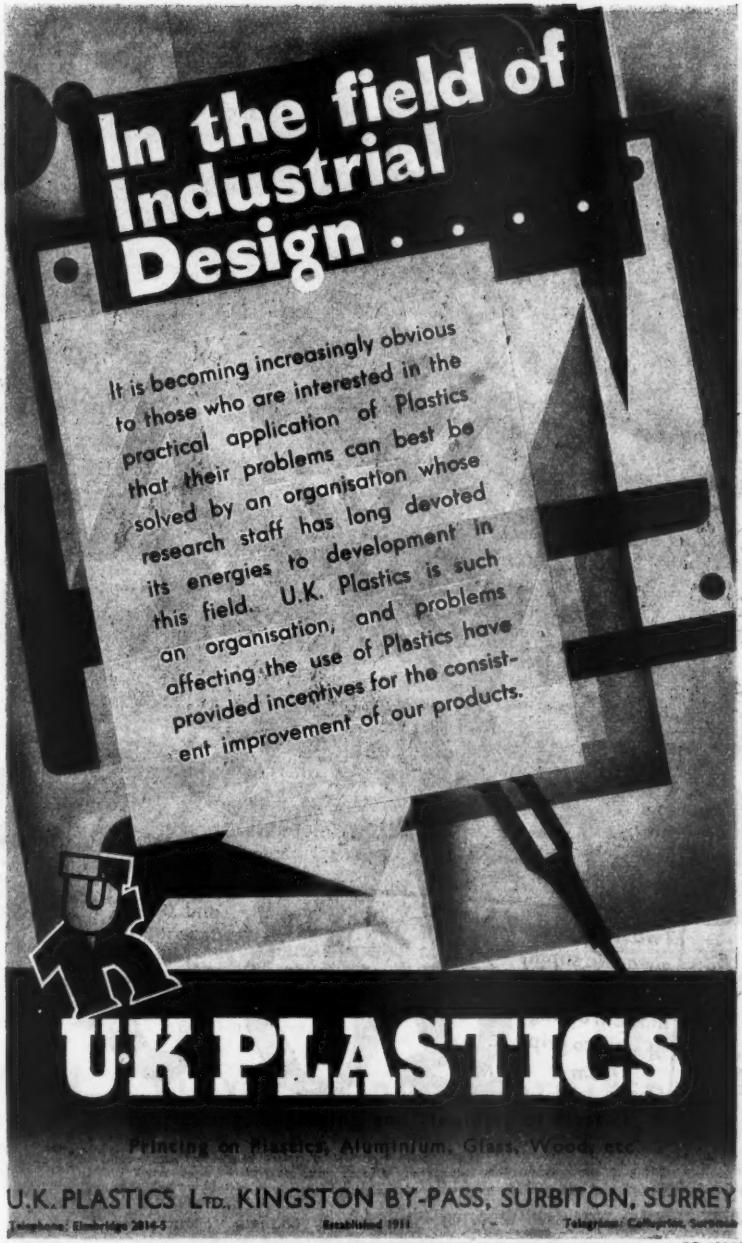
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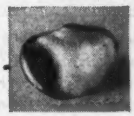

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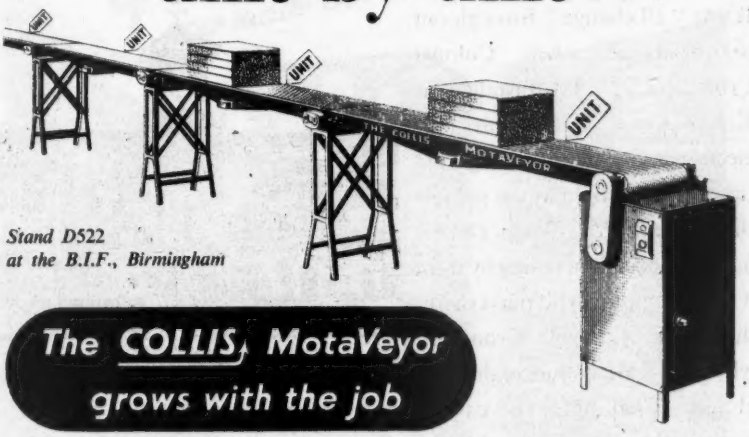

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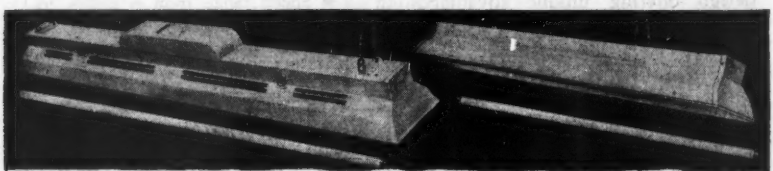

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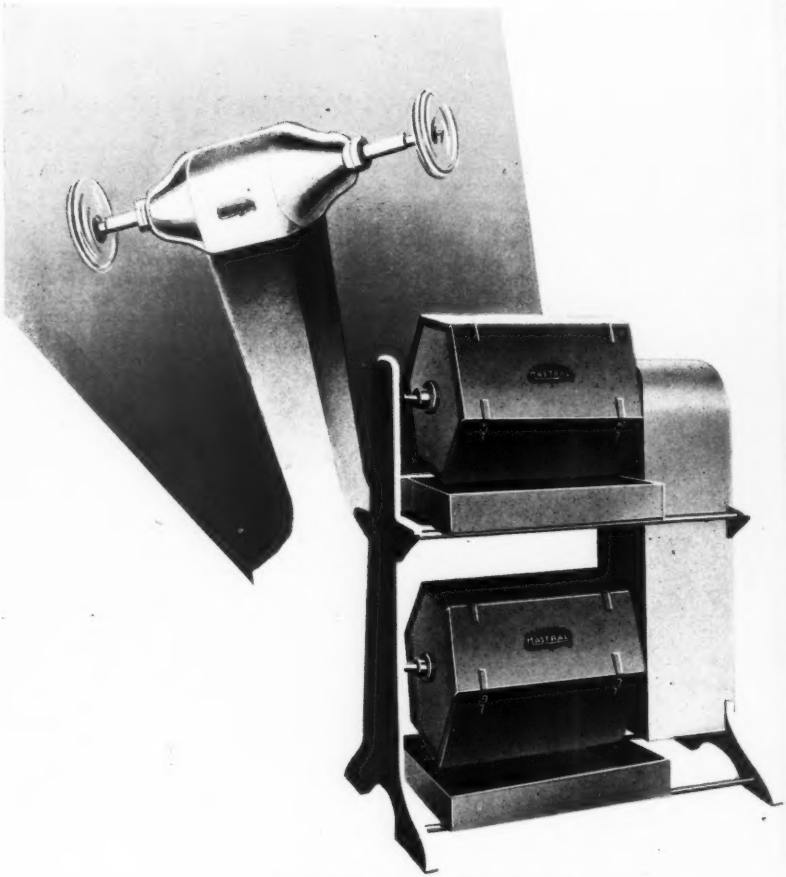

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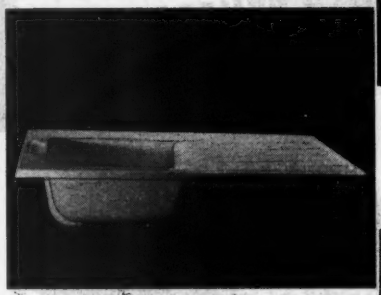

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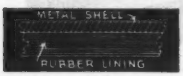
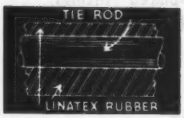


OLD METHOD consists in bonding, or fixing mechanically, a rubber lining to the internal surfaces of the drum.



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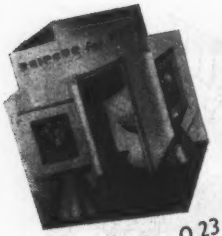

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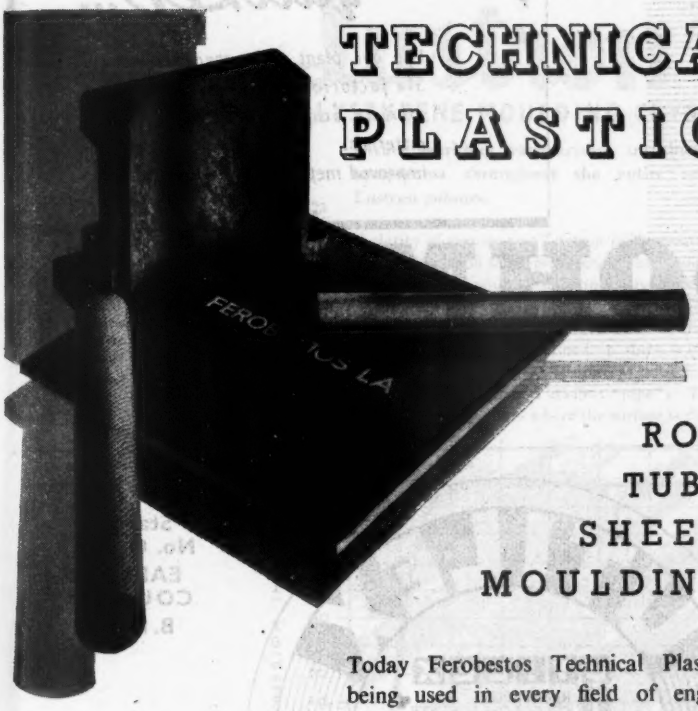

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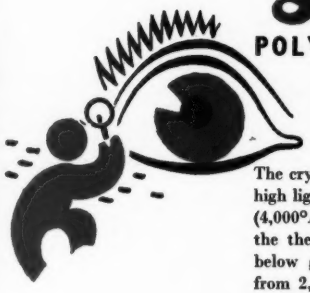

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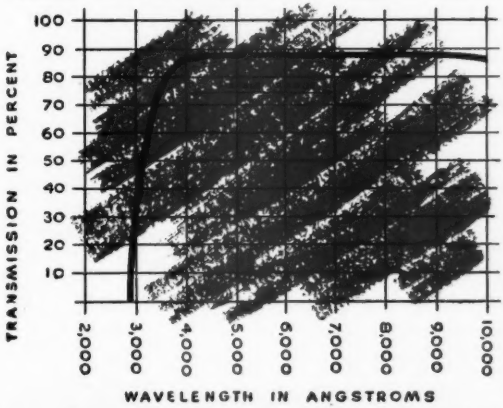

Percent Ultimate Elongation vs. Temperature of Lustron

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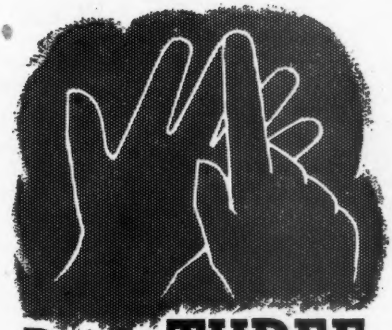

Point THREE

IN CONSIDERING PLASTICS

WHAT ABOUT THE MOULDS? The design and manufacture of the moulds are operations which call for a high degree of skill and long experience.

The Customer and the Moulder should consult together in the early stages of the design whether the article is a colourful fancy piece or a precision engineering part.

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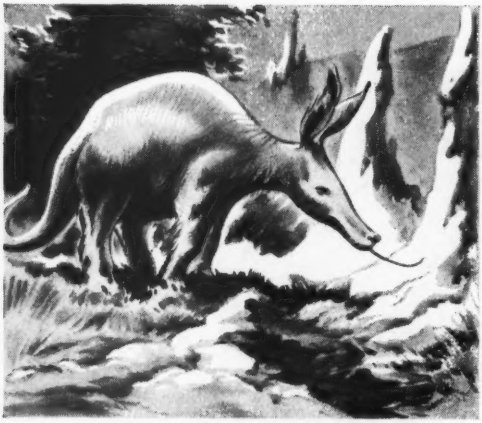

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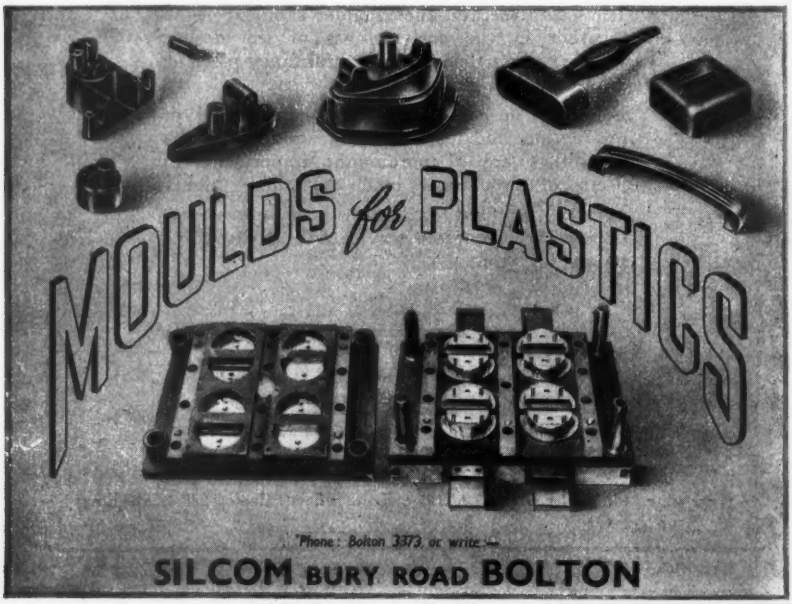

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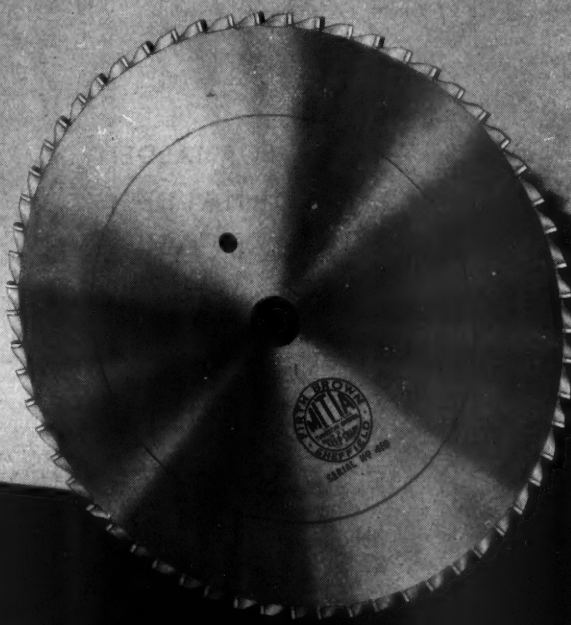
"MITIA" CARBIDE TIPPED



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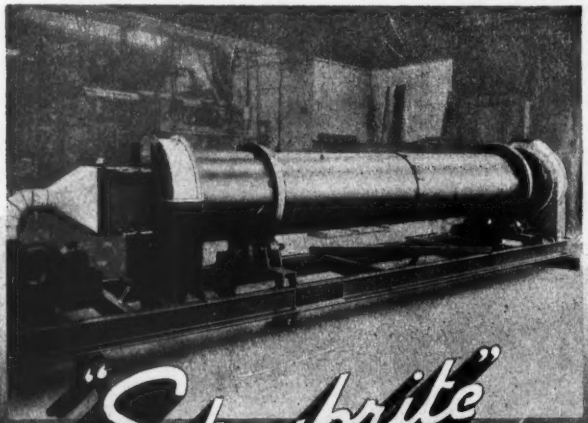

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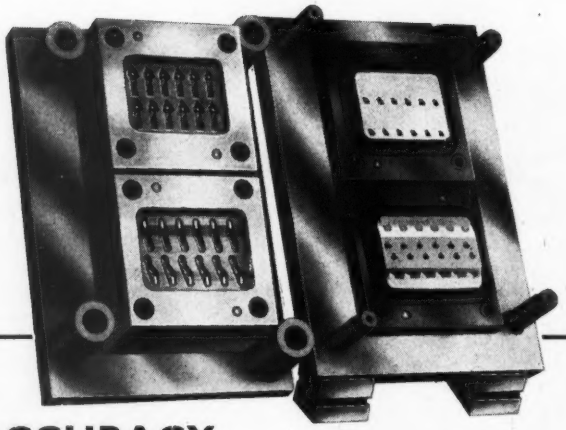

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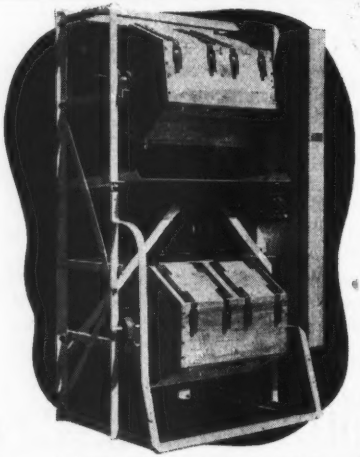

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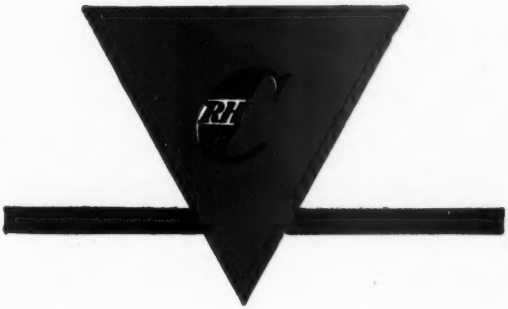

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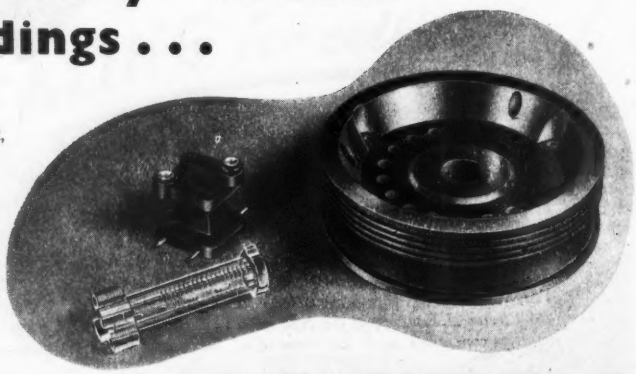

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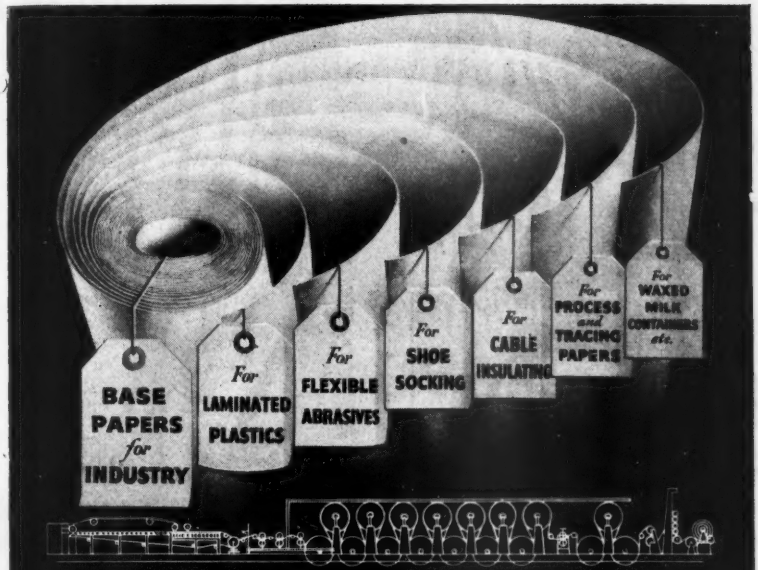

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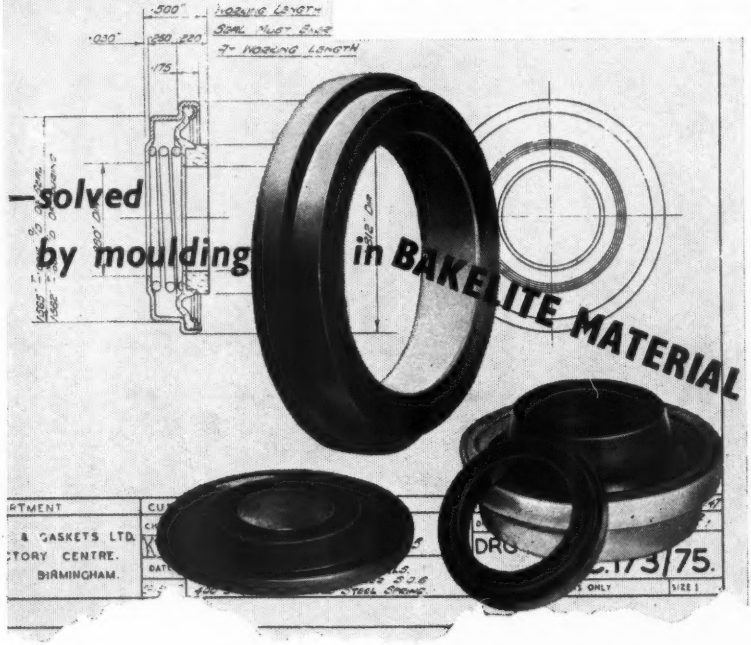

The seal was moulded in BAKELITE water-resistant material X.5448/1 and incorporated as an insert in a rubber surround. Although, in use, it is pressed against the impeller boss of the water pump and subjected to continual friction it remains watertight longer than any other type of seal. It is equally efficient when exposed to chemical attack from refrigerants.

Mouldings were designed and produced by Super Oil Seals and Gaskets Ltd., Birmingham, using BAKELITE water-resistant material X.5448/1.

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Vol. XII. No. 131 APRIL, 1948

Plastics

Dealing with the Manufacture, Uses and Potentialities of Plastic Materials

Proprietors - - TEMPLE PRESS LIMITED
Managing Director - ROLAND E. DANGERFIELD

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NOTICES

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EDITORIALS

British Industries Fair

THE fair at Earls Court, Olympia and Castle Bromwich, is a much more convenient opportunity than is the first day of the year to review industrial growth. The visitors from the edges of this island and our friends from abroad may with their own eyes see the basic nature of and the changes that take place in our industries—a more satisfying method than reading of them in an annual technical review.

So far as our own industry is concerned, it possesses a quality possessed by no other; for indeed it is the plastics industry alone that enters into the manufacture of such a variety of products as to be bewildering and almost unbelievable. For how else can one describe it when one of its factories may be producing simultaneously fancy bottle caps, electric-iron handles, large radio cabinets, tiny shirt buttons or textile bobbins? Another type will be making aeroplane gun turrets, kitchen sinks and flower-containers; another extrudes plastic strips; and yet another builds bulkheads for ships. It is all very confusing at first sight, but all of them derive basically from a very few raw materials of organic origin, the most important being three only—coal, petroleum and cellulose—which by chemical reorganization are changed into entirely new materials which can be shaped into a thousand different forms by heat and pressure.

It is an industry which is said to employ about 60,000 workers and to produce goods valued at some £65,000,000. These figures are debatable, for the whole of the synthetic textile industry employs viscose, cellulose and nylon, which are also raw materials for the plastics industry. This very month we see yet another plastic, this time produced by BX Plastics, Ltd., in monofilament form 1/100 in. thick, being adopted by a 100-year-old Manchester textile concern, Fothergill and Harvey, Ltd., for weaving new upholstery materials, luggage covers, chemical filter cloths and fly and mosquito netting. Little wonder that it seems confusing. But it is also very exciting, and we can promise visitors a technical feast of kaleidoscopic variety and colour.

High Spots

IT is always invidious to point to those exhibits or to those manufactures during the past year which are considered as deserving of special merit, since such a choice is often a matter of taste or personal opinion. Yet we believe that there are several which are so outstanding in the rapidly changing scene as to deserve the attention of the visitor who is not acquainted with the full extent of our ability to adopt new raw materials and new processes or of the flexibility and extent of our industrial technique.

In no special order we may mention the following: A transparent corrugated "Perspex" has become of special importance during the past year for temporary and permanent factory lighting. It is being welcomed by every factory manager, who, in these days of shortage of timber and glass and of carpenters, is almost at his wits' end to supply lighting to corrugated roofs. This metal roofing may not be a thing of beauty, but it is a strong, useful structure and lighting through it is important and sometimes essential. The ease with which an unskilled worker can replace a metal section with a "Perspex" one of exactly the same size is as noteworthy as the result is efficient. Quite apart from the time saved in installation and the poor quality of wood now available, we have every reason to welcome this new development.

Another example of structural work which we hope will be seen at Earls Court is a telephone booth by Holoplast, Ltd., made from that amazingly strong laminated form of plastic, "Holoplast," built on what may be called the I-engineering principle. Its main value here is its soundproofness and its toughness under very rough treatment.

The modern technique in expanding plastics to produce ultra-lightweight forms for use as sponges, ships' buoys, cistern balls and insulations has advanced still farther and in one instance both in an important and an amusing direction. Expanded Rubber Co., Ltd., now manufactures a foam expanded urea resin in such a featherweight form that it is a highly acceptable substitute for snow without the latter's disadvantageous qualities of coldness and wetness. Lovers of British films can now be assured that snow films will not be the prerogative of Hollywood, that they can be made without the aid of British meteorologists and that the cast-off heroine may now wander forth with a real babe in her arms without interference from the R.S.P.C.C. Joking apart, this is a notable advance, important also for insulation and other applications.

Vinyl compounds in general appear to occupy much of the headline space. A notable exhibit by Duratube and Wire, Ltd., will be a new form of extruded p.v.c. strip. Hitherto conceived only capable of change in cross-section, new surfaces have been produced by ingenious control of the machine, for "embossings," "curled edges" and "folds" have been made by extrusion without the aid of a secondary process such as calendering, giving lovely entirely new effects which greatly widen the scope of the material.

For the first time, too, we shall see on the stand of Tenaplas, Ltd., that rigid type of p.v.c. we have long waited for, more or less free of plasticizer and therefore more dimensionally and qualitatively stable. Tenaplas, Ltd., will show a variety of strip extruded from this material and especially recommended for use on ships.

Vinyl compounds have finally yet another advance to their credit; one about which amateurs and professional casters of plaster and liquid resins of the Cataform type have been dreaming about for years. Vinyl Products, Ltd., have produced "Vinamold," a soft yet strong resilient compound which can be made into a mould by simple melting and pouring over an original casting or shape. This mould is then used for the casting of plaster or resin from which the mould can be removed by stretching and re-used 200 or 300 times. Vinamold would appear to have sealed the doom of gelatine hitherto used for this purpose.

We especially welcome the introduction to this country of Geon, that polyvinyl compound plasticized with butadiene-acrylonitrile, which is quite non-volatile, thus enabling extrusions and other forms to be much more dimensionally stable and less changeable with time and weather than, say, p.v.c. plasticized with the old type of plasticizers. This will be shown at the British Geon stand.

Referring again to the "phenolic" field we look forward to the inclusion on the Dufay Chromex stand of a complete aircraft wing or part of one, constructed of "Dufaylite" honeycomb structure made from resin-impregnated paper. The high-strength figures published recently by our air research authorities at Farnborough and the fact that experimental wings have been built there augurs well for the new development.

We cannot resist placing in these high categories the production by E. K. Cole of a new portable radio set, for we have always preferred plastics to be used for the small variety rather than for the large. There are great problems in such a construction since dimensional stability and toughness are so important and the result, using cellulose actetate-butyrate, which possesses these properties to an adequate degree, appears a happy one.

Finally we wish to record not a new material but a new little industry. Examples will not, we believe, be shown at a special exhibit, but we hope that one of the results will be visible at our own

"Plastics" stand. It is a carboy, a receptacle for acids, made by a new casting method from that very resistant plastic polythene. The single object represents one of a varied production from the works of the newly formed Rediweld, Ltd., whose activities we describe on page 169.

We have included only those new advances of which we have personal knowledge. Obviously, however, there will be much more of novelty, especially among some of the mouldings which will remain unpublicized until the opening of the Fair. We ourselves expect surprises to comment on.

Yes, we shall have a special technical feast this year.

Failure

ABOUT two years ago in these pages we discussed learnedly the production of coinage from plastics, and wandered in time between the wars of the Dutch Republic, where thick parchment coins were produced, to Chilean troubles in 1909 and Chilean celluloid pieces, to the modern B.A.O.R. in Germany and penny resin-laminates.

Such productions were interesting, although we believe no plastic moulder would be enthusiastic, in his private opinions, if suggestions for this new production were made. He would, we believe, prefer even the miserable nickel type we have at present, although he might accept plastics rather than the even more miserable aluminium coins we see abroad.

It appears, however, that the matter of new coinage has been taken up by very high authorities. Because of the extreme shortage of metal, the U.S.A. did, indeed, trifle with the idea of using glass coins, and we now have before us the Annual Report of the Deputy Master and Controller of the Royal Mint, which contains some interesting, although (to plastic-coin enthusiasts) not very comforting, news.

"The possibility was examined of using one of the new plastic materials for coinage to save metal," says the report. "Unskilled, if superficial, counterfeiting of such coins appeared easy. The materials were found to be most unlikely, when subjected to the ordinary conditions of use or abuse of coin, to retain their integrity of shape and design. The extreme lightness of such coins, both individually and in quantity, is in itself a serious drawback. For although accumulators of small change sometimes grumble at their burden, it would be more inconvenient that a penny should fall soundlessly or be blown away by the wind. Persons who have to handle and reckon coin in the mass would also be deprived of the use of scales and have to count separately each unit in the flood."

These rather mournful conclusions would appear to put an end to any hopes anybody might have sustained of filling our pockets with phenolic stivers, polythene tanners, urea bobs, or acrylic jimmy-o'-goblins.

A little consolation is given in the report by the statement that "the use of plastic material was, however, recommended and adopted for the Commemoration Badge instituted in 1942, and for the Mentions Emblem instituted in 1943."

Pictures in Plastics

A REMARKABLE discovery by the Corning Glass Co. of America has resulted in the activation of glass, so that permanent photographs with considerable stereoscopic effect are obtained.

The process is that of incorporating metallic particles of microscopic size in the glass, followed by exposure to ultraviolet rays which have passed through a photographic negative; the metallic particles are thus suitably activated.

If the process is simply one of activation of metallic particles, there seems no obvious reason why transparent plastic of any thickness could not be decorated. Obviously the invention has tremendous possibilities for glass, but its application to plastics, the decoration of which is, unfortunately, so limited, would in one sense be of still greater importance.

Fig. 1.—The 10-gallon polythene container (extreme right) weighs only 7 lb., in contrast to the lead container (extreme left) weighing 84 lb.

A New Plastics Fabricating Industry

EVEN those who are not especially interested in the subject will have noted in these pages during the past 10 years the steady evolution of new methods for the fabricating, welding and joining of thermoplastic to thermoplastic as differentiated from the processes of jointing plastics to metal, wood, etc.

All the theoretical and practical research in these fields that has been carried out for these many years and at a very great rate during the war, has now crystallized into a very acceptable form with the formation of a new company, Rediweld, Ltd., with works in Wandsworth, London, S.W.18. Moreover, while the processes referred to above form an important part of the function of the company, there are also being evolved, on a practical scale, new methods of fabrication which, although at first sight of limited application, are of immense importance to special sections of industry.

Welding of Thermoplastics

Such new methods are, it is important to point out, interwoven with the welding processes indicated, as will be apparent in the following general description of the work being carried out.

The welding technique has, of course, already been adopted to some extent by the industry, and as the methods and processes become better known, will be adopted to a greater extent, for as we have already noted in these pages, raincoats, tobacco pouches, spectacle cases, purses, water and medicine containers, toys, etc., have been produced from polyvinyl chloride sheet, for example, by utilizing high-frequency methods.

It is certain that this so far specialized industry, which is only in its very beginnings, will expand. It is equally certain that it is only one method, which has its limitations, depending on the plastic employed and also on its shape. Other methods, such as heat sealing and hot gas welding, are also steadily coming into prominence.

It would appear that the new company will engage itself in all the above methods, and any new method that comes into this province of joining one thermoplastic component to another; several types of high-frequency welding machines, heated tool welding outfits and gas-welding plant, are already installed there; new devices and machines for producing new shapes will shortly be

introduced. Of the greatest interest, however, will be the possibility of providing the chemical and allied industry with very important tools.

Plastics and the Chemical Industry

We have often made the comment on these pages that the real testing grounds for the raw materials of our industry are three: the engineering industry, the electrical industry, and the chemical industry, or, to put it in another way, in those industries which employ the physical and chemical sciences consciously in their techniques. One can say that if the plastics industry can satisfy these industries, then it follows as a truism that it will satisfy almost all others.

It is, therefore, of first-class importance to note that Rediweld, Ltd., are tackling with considerable vigour certain problems which continually face the chemical industry—problems which cover the vast field of corrosion.

Some of the simpler results of the work are already on the market. For example, laboratory equipment for use with strong acids is fabricated by gas welding of polythene, which lends itself ideally for the purpose (Fig. 1). Of perhaps greater importance is the production of acid containers, especially of the transportable type known generally as the "carboy"—and herein lies a story in itself.

Most people are familiar with the bulbous glass container of about 5 to 10-gallons capacity surrounded by a steel "wicker-work" basket stuffed with straw to prevent the glass carboy from being broken. It is, in fact, at present the only method of transport for nitric, hydrochloric, sulphuric and other corrosive acids used by metal picklers, garages, metal refiners, in such small quantities; it is never a safe method of handling and neither railway nor road-transport people are comfortable about it. If such a carboy is broken during transport, the fire-brigade must immediately be brought to the site to wash the contents away.

In telling this story of one of the simplest jobs in the chemical industry, we have purposely omitted the special case of the problem of transport of one particular acid, namely, hydrofluoric, an acid which, until recent times, was used almost solely for the etching of glass. To-day its use has expanded in strange directions, but it will be obvious that it cannot be transported in glass carboys. In this instance, the problem becomes even more acute. Originally containers were made of gutta-percha, which is now extremely difficult to get. In more recent years, recourse has been had to lead; which is not only expensive, but, what is worse, extremely heavy. A lead container is some four to five times heavier than one of equal capacity in glass, so that transport costs increase greatly.

Rediweld, Ltd., have solved the problem brilliantly by the introduction of the polythene carboy. This tough plastic

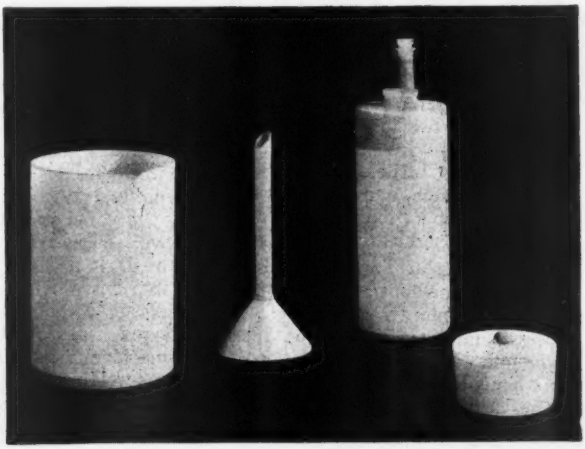

Fig. 2.—Laboratory equipment of welded polythene, for use with strong acids, particularly hydrofluoric acid.

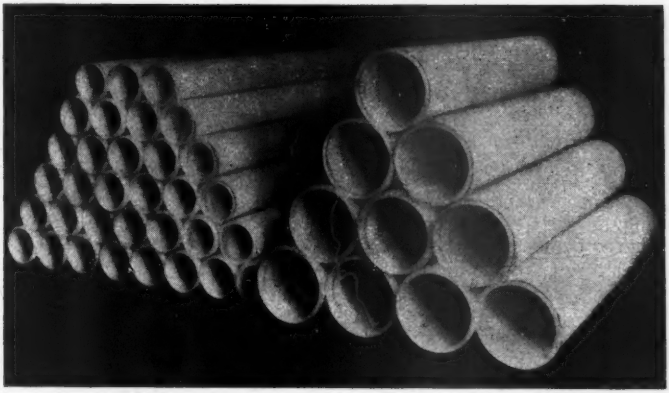

Fig. 3.—Polythene pipes for use at chemical works are available with internal diameters ranging from 2 to 12 inches (the pipes actually illustrated are 3 in. and 5 in.)

material is one of the few substances that will withstand the corrosive action of hydrofluoric acid, in addition to many others. Futhermore, it is lighter than water and only one-twelfth the weight of lead, so that from all points of view polythene would appear to be the ideal material for the job. A lead container weighing 87 lb. has the same capacity as the plastic container weighing only 7 lb. (Fig. 1).

These polythene containers are made by casting the hot molten polythene into container-like shapes and subsequently cooling; this process was developed in the plastics research laboratories of I.C.I. (B.P. 567,012) and is now being used on a commercial scale by Rediweld, Ltd.

Production of Polythene Pipes

Another problem of outstanding importance within chemical factories and allied industries is the conveyance of corrosive acids and other liquids from building to building, from one reaction vessel to another, and, finally, from reaction vessels to filling points. This piping, or tubing, for the conveyance feeding, and condensation, etc., of acids and acidic salt solutions, alkalis, and corrosive gases is a normal continuous occurrence in such factories.

In all such cases, polythene tubing is of extreme value, limited only to the fact that being a thermoplastic, it can only be used up to a temperature of 60 degrees C. Even so, the field is very great.

Obviously for their production, since the units are very often of large diameter,

Fig. 4.—Polythene lining as applied to a 10-gallon steel drum.

special methods other than extrusion must be adopted.. Rediweld, Ltd., have adopted a pipe-spinning process of very special interest.

In essence, the process consists in loading a metal tube, the internal diameter of which is equal to the outside diameter of the desired polythene tube, sufficient polythene powder to give the required thickness is filled into the tube, which is laid on the spinning plant. The powder is then spread equally throughout the length of the metal tube, which is then rotated at a constant speed. The outside of the metal tube is then heated so that the polythene melts and coats the inside with a film which gradually builds up to the required thickness. The two ends of the metal tube are suitably fitted with flanges to prevent an outflow of either the powder or the fluid polythene.

On cooling, the polythene solidifies to its normal tough form and in doing so retracts sufficiently for the finished pipe to be easily removed. By such means plastic pipes (Fig. 3) are now being produced, ranging from 2-in. internal diameter up to 12-in. diameter. All pipes are 3 ft. long, and it is interesting to learn that it is also possible to produce them up to 3 ft. 6 ins. in diameter. This process was invented in the laboratories of I.C.I. (B.P. 585,393) and developed on a commercial scale by Rediweld, Ltd. In the polythene section of the works, polythene valves, stop-cocks, buckets, jugs, etc., are also fabricated.

As a final note on this subject, we may mention that polythene withstands satisfactorily up to 60 degrees C. the action of the following acids and other chemicals:—Acetic acid (10 per cent.), ammonia (sp. gr. 0.88), caustic potash and soda, citric acid, formaldehyde, hydro chloric acids (all strengths), hydrofluoric acid (75 per cent.) nitric acid (70 per cent.), phosphoric acid (30 per cent.), and sulphuric acid (70 per cent.).

Contact-pressure Resins for Laminates

LOW-PRESSURE thermosetting resins for laminates, castings, surface coatings, moulding compositions, adhesives, etc., are described in brochures issued by Scott Bader and Co., Ltd., 109, Kingsway, London, W.C.2. These resins were first developed in the U.S.A. in 1942, but under an exclusive licensing agreement they are now manufactured in England for distribution to the European and Australasian markets. They are liquids of adjustable viscosities, which may be cured rapidly in the presence of peroxide catalysts to a solid insoluble and infusible state. Certain members of the series will do this at room temperature, but others need heat to effect a cure.

In their general characteristics the Marco resins present a combination of many of the advantageous properties of both thermosetting and thermoplastic synthetic resin types. Laminates which would otherwise be too large or complicated, can be made at pressures less than 14.4 p.s.i., with temperatures ranging from 140 degrees C. down to as low as 30 degrees C. Examples of contact-pressure lamination include suitcases, wing-tips, air ducts and the hulls of small boats. Table tops, wall panelling and laminated board can be manufactured at pressures less than 100 p.s.i., and, if necessary, at room temperatures; even under these conditions of low-pressure lamination, an amazing degree of interlaminar cohesion is obtained.

As regards casting, hardness and toughness are outstanding features of sheets, rods, tubes and articles of other shape, either clear or coloured, which may be cast-polymerized at temperatures as low as 30 degrees C. In this application, the moulds need not be made of highly polished steel, for white metal, wood, glass, plaster and even rubber are just as suitable. Used as adhesives, the Marco resins are capable of withstanding temperatures as high as 250 degrees C. Some of the resins have been developed to yield 100 per cent. polymerizable surface coatings for metal, wood, glass and paper, thus providing weather-resistant films without the use of solvents.

PLASTIC "CROCKERY."—Due to general shortage of china cups and saucers, J. Lyons and Co., Ltd., are introducing white plastic coffee cups and saucers in 30 of their City, West End and suburban London teashops. Plastic teacups and saucers will follow later.

EROS, ANTEROS—CUPID, AMOR

The Greeks, and the Romans in their turn, had several words to name the mischievous son of Aphrodite. We have only one to describe the above plastic reproduction of him—we are sure Praxiteles would have approved—for it is truly "superb." We have selected it as representative of the height which mould-making in this country can attain, rather than for any other attribute. The figure was presented to the Editor by the producers, Fraser and Glass, Ltd., of London, before the war, and, of course, never saw the ordinary light of day. Now that the piping hot days of peace are with us, it seems an appropriate time to show what can be done.

Cellulose Acetate Plastics

XI.—Manufacture of Moulding Powder

By
Vivian Stannett

SOMETHING like 80 per cent. of the cellulose acetate plastics used are first prepared in the form of moulding powder; consequently, the manufacture of moulding powder is a most important and substantial industry. Cellulose acetate plastics have been shown to consist, in effect, of a solid solution of plasticizer in polymer, and the main concern of the moulding-powder manufacturer is to incorporate these two components into a sufficiently homogeneous and intimate mixture. In addition, any pigments, fillers, dyes or lubricants must also be completely dispersed during the manufacturing process.

At the present time, methods available for carrying out these processes fall mainly into two classes, known as wet and dry, according to whether volatile solvent is used in the method or not. In this country wet, i.e., solvent, methods are preferred, whereas in the U.S.A. the tendency is towards solventless, or dry, methods. Both classes are tedious and laborious processes; however, efforts have been made to develop more elegant methods, and some of these more recent developments will also be described.

The Wet Method

The first part of the wet method follows closely the block method of sheet production, but for the sake of completeness, and because there are some differences, it is important to outline this method from the beginning.

The cellulose acetate, plasticizers, fillers, pigments and other ingredients are weighed out and loaded into a dough mixer of the Werner-Pfleiderer type. The volatile solvents are then added in the proportion of about 70 parts solvent to 100 parts of cellulose acetate by weight. The amount of solvent added has a considerable effect on the power demands of the mixer, as well as on the time required to complete the mixing.[1] When a minimum of solvent is used and a heavy and stiff dough results, the power peaks are proportionally high, especially during the earlier mixing period. Later, the power peaks will level off, but the average power consumption is naturally high. It is more useful to use an excess of solvent; this appreciably lessens the power peaks and gives a lower average power consumption. This leads to a longer time cycle, however, as conglomerates of acetate, pigment, etc., are more readily broken down with a heavier dough and there is, of course, more solvent to be evaporated.

The solvent can consist of acetone or acetone-alcohol-benzene mixtures. The mass is stirred continuously until it becomes completely homogeneous, which usually takes something of the order of 2-5 hrs. Towards the latter end of the mixing, suction is applied and the solvent content of the mix is reduced to an amount consistent with leaving the mass in a workable condition on cooling. The mix is then ejected from the mixer and taken to the milling rolls.

For light pastel shades or transparent coloured powder it is often desirable to filter the stock before the rolling process. This is carried out using massive vertical stuffing presses. The plastic stock is cut up and placed in the cylindrical filter pot, the bottom of which is closed by a heavy drilled filter plate, on which is clamped a system of metal gauges and filter cloths. The plastic is forced throughout this filtration system by the ram, which descends into the cylinder under high

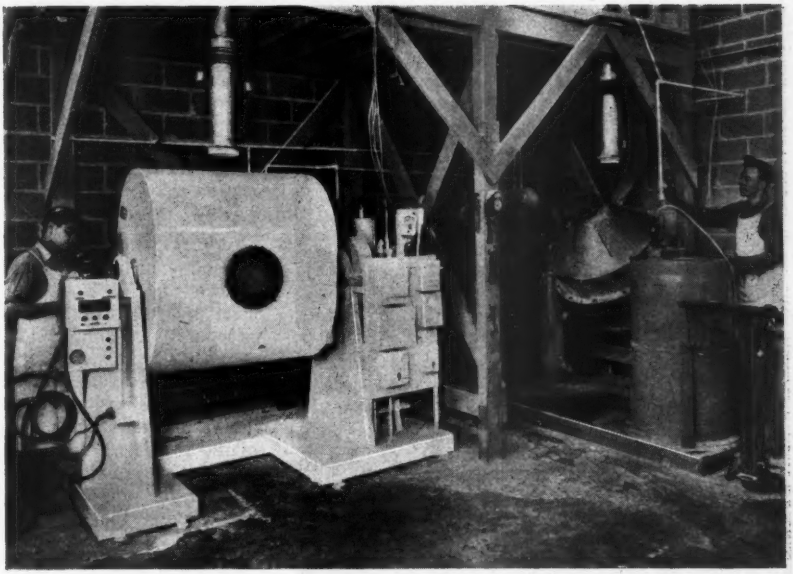

Fig. 1.—"Plastimaker," capacity 150 lb., with heating jacket; a smaller unit is seen in background to right. (Courtesy, Hungerford Plastics Corporation, Murray Hill, N.J., U.S.A.)

pressure. The filtered stock is then transferred to the milling rolls.

The milling equipment consists of two massive rolls, situated horizontally next to each other with an adjustable gap, and are similar to ordinary rubber milling rolls, but are completely enclosed except for the front and are fitted with a suction hood attached to a powerful draught. The rolls are cored for heating or cooling by the passage of steam or cold water respectively.[2]

The plastic mass is cut into batches and dropped into the gap of the rollers, which are kept well heated by passing steam through them. The stock forms a blanket round the front roll, this being kept at a higher temperature for this purpose. The blanket is continually cut and thrown back into the rolls to give it an efficient mixing and working. Except for very small sets of rolls, two operatives usually work on each set. When the solvent content has been reduced to a few per cent. only, the stock is transferred to a set of hot sheeting rolls, where it is run off as a thick sheet.

In some factories the milling rolls are tightened up and used for sheeting out the stock. Towards the end of the rolling the heat is often stepped up to give the maximum efficiency of solvent expulsion. The thin sheet of plastic is then hung or stacked in hot seasoning rooms for several days. The seasoning rooms are fitted with suction, and here the solvent content of the plastic is reduced to below 0.1 per cent. Finally, the sheet is taken out, broken up into smaller pieces and mechanically ground down to the required size. Dust and fines are removed by the usual methods, and the screened moulding powder is then ready for packing and shipment.

The Banbury Method

Dry methods of manufacture involve the complete solution of plasticizer in

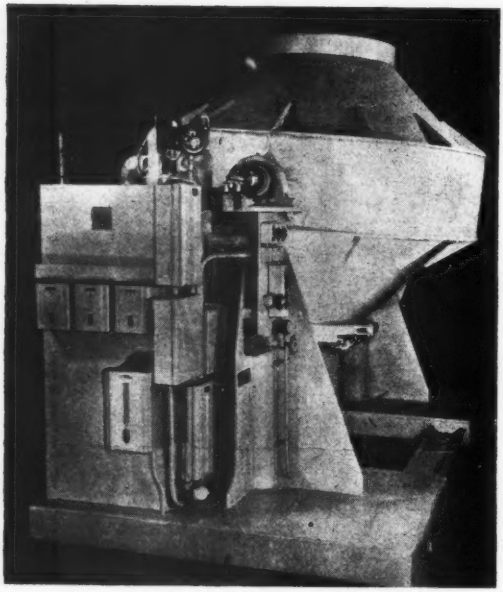

Fig. 2.—"Plastimaker," capacity 1,000 lb. per hour, scale and plasticizer tank not shown. (Courtesy, Hungerford Plastics Corporation.)

polymer by heat and thorough mastication. Two general ways are available to carry this out, both of which are used in other branches of the plastics industry for plasticizer - polymer compounding. The first method involves the use of an internal mixer of the Banbury type.

The Banbury method uses a heavily jacketed mixing vessel with the centre ridged. In the two troughs of the vessel, i.e., on each side of the centre ridges, two heavy rotors revolve towards each other at different speeds. The blades spiral along their length. The rotors themselves are coned for steam heating or water cooling. The body of the mixer itself can, of course, also be heated or cooled by the passing of steam or water through the jacket. The ingredients are fed into the mixer through a hopper at the top, and are kept in by means of an air-operated weight piston in the feeding entrance. The contents can be ejected from the mixer when required through an outlet at the bottom; this is normally kept closed by a sliding cover.

Very efficient mixing takes place between the rotors, and between the walls of the vessel and the rotors. The procedure is simple; the ingredients are added, that is, the cellulose acetate, plasticizers and colouring matter, without the addition of any volatile solvents. The mixer is closed and mixing started up with the application of heat through the shell and the rotors. In a comparatively short period of time the whole mass has been converted into a hot and homogeneous dough. This is ejected at the bottom and immediately transferred to a set of heated sheeting rolls, where it is run off in the form of rough, thin sheet, as in the wet method. Often a mechanical conveyor belt takes the plastic stock directly from the Banbury to the sheeting rolls.

Usually the plastic is worked on the rolls a little before the sheeting, to finish off the mixing process completely. As no solvent is used in this method, no seasoning is necessary and the sheeted plastic can be immediately broken up and ground to the correct size. It is usual to dry the powder to remove any moisture which might have been present in the original ingredients before finally packing the powder preparatory to dispatch.

Hot-rolls Method

The hot-rolls method[3] is, perhaps, the simplest method. It consists merely of adding the ingredients (which are usually roughly mixed beforehand) to a set of very hot milling rolls of the type previously described. By working this mass

strenuously complete homogeneity can eventually be obtained. When this has been achieved, the plastic stock is run out in the form of thin sheet, as before, and then broken up and ground to the correct size. Any dyestuffs which need to be added can be dissolved in the plasticizer.

The temperature necessary for efficient compounding varies with the nature and proportion of the plasticizers and other ingredients present, but 145 degrees C. for the front roll and 130 degrees C. for the rear roll would ordinarily be suitable for powders of standard formula. The mixing of the ingredients before adding to the rolls is important, and methods are possible which involve a light kneading action on the cool ingredients. An interesting patent[4] describes this process, laying great stress on the need for strict temperature control. This must be kept above the crystallizing point of the plasticizer but below its solution temperature for cellulose acetate. This point varies from plasticizer to plasticizer and is around 15 degrees C. for dimethyl phthalate and 8 degrees C. for triacetin.

A neat extension of the hot-rolls method is described in another patent[5] from the same company as the premixing patent. By this method, or by any other suitable process, the ingredients (first mixed below the solution temperature) are fed continuously into the gap on a rotating hot-rolls mixer. The feeding is carried out from a hopper situated at one end of the rolls. A suitably placed guard-plate prevents the material working off the rolls at the hopper end. The plastic forms a blanket round the front roll, where it is worked into complete homogeneity. At the other end of the rolls, i.e., the end farthest from the hopper feed, a knife running up against the front roll cuts off a narrow band of hot plastic. This strip is taken off the roll and over a small guide roll as a continuous ribbon. It is first slit into a number of very narrow strips, and these pass through a cross-cutter which cuts them off in the form of small nibs. As the strip is in a semi-plastic condition, during the cutting operation, it is stated that no "fines" or dust results and the product is in a suitable condition for moulding purposes.

The dry methods are reasonably efficient, although the rather drastic measures used, such as the high compounding temperature, can lead to slight discoloration of the cellulose acetate. With modern grades of highly stable acetate, however, this is not very likely. A more serious objection is the high power consumption of these methods, which has been estimated to involve approximately the power of a 500 h.p. motor for one hour to carry out the effective compounding of about 1,500 lb. of moulding powder. Heavy-duty equipment needed for both of the dry methods, and the wet method, is very expensive.

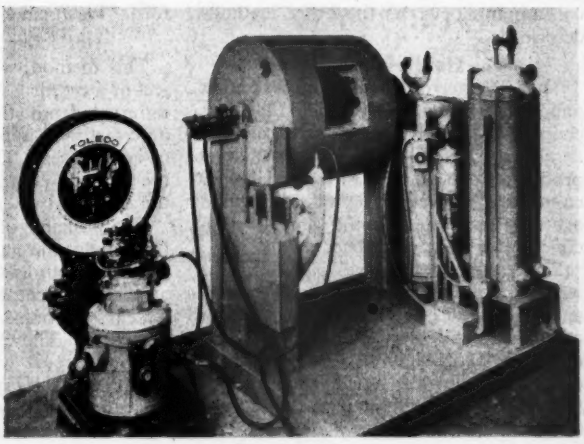

Fig. 3.—Laboratory size "Plastimaker," capacity 40 lb. (Courtesy, Hungerford Plastics Corporation.)

Table 1.—Examples of cellulose acetate moulding powder formulæ.

	(1) parts	(2) parts	(3) parts
(a) General			
Cellulose acetate (52-54.5% acetyl value)	100	100	100
Dimethyl phthalate	20	35	25
Diethyl phthalate	20	—	5
Triphenyl phosphate	—	—	10

	(1) parts	(2) parts	(3) parts
(b) Hot-acting solvent method [9]			
Cellulose acetate (54.5 % acetyl value)	100	100	—
Cellulose acetate (57 % acetyl value)	—	—	100
Dimethyl phthalate	31.5	31.5	8
Diethyl phthalate	13.5	13.5	24
Ethyl alcohol } hot-acting solvent	42	26.5	—
Water alcohol } hot-acting solvent	8	6.4	—
Methyl acetate } hot-acting solvent	—	—	36
Ethyl alcohol } hot-acting solvent	—	—	20

These disadvantages have led to a determined effort being made to develop other methods of moulding-powder manufacture based on rather different principles. Of these, two appear to be extremely promising and will be described. Before doing this, however, it might be as well to mention that, in addition to the solvent and non-solvent methods of manufacture already described, some makers wet down the cellulose acetate and plasticizer with a non-solvent, knead this as a premixing operation and then roll out, using hot rolls as before. Water, to which a few per cent. of alcohol is added as a wetting agent, is a common diluent for use in this type of method. Naturally, this modification has substantially the same disadvantages of power and time consumption, etc., as the other methods described.

The Hungerford Method

The Hungerford method[7] was first announced about a year ago.[6] It is claimed to be extremely successful and is already being used for commercial production in the U.S.A. and other countries. Exact details of the method are not disclosed, but the general principles have been described.

This method involves loading the weighed cellulose acetate, together with any other solid ingredients, into the drum of a specially designed compounding chamber. This slowly rotates whilst the correct amount of liquid plasticizer is sprayed on to the solid ingredients from a special atomizing-spray device. This operation takes about 40 mins. to complete. Finally, hot air is blown through the mixer to dehydrate its contents; this takes about 30 mins. The powder is then emptied from the mixer and is ready for immediate use or packing.

The mixer is fitted with a heating jacket, to be used if required. It is claimed that a 5 h.p. motor, operating for one hour, can produce 1,500 lb. of satisfactory moulding powder by this method. Two interesting Celanese patents[8] had already described the principle of spraying the plasticizer on to the cellulose acetate, and the Hungerford Plastics Corporation have incorporated features of these patents into their process by agreement with the Celanese Corporation. Figs. 1, 2 and 3 show three commercial models of the Hungerford "Plastimaker."

Hot-acting Solvent Method

This method, which has been the subject of a recent U.S. patent,[9] is completely different from the methods previously described and appears to offer a number of advantages. The chief advantages are the ease of controlling the process and the comparative ease of solvent removal.

The principle of the method is to form the cellulose acetate (or other derivative) into a smooth and homogeneous mass at an elevated temperature, using a solvent which is a non-solvent at normal temperatures. The temperature at which solution occurs will vary with the solubility characteristics of the cellulose derivative and the plasticizer. On cooling the mass, whilst stirring, gelation and

granulation occur. The moist granules can then be spread out and dried.

Owing to the large ratio of surface to volume, this is an efficient and speedy process. One method is to mix the cellulose acetate, plasticizers and other ingredients with the solvent mixture in a standard dough mixer, meanwhile heating the mass by circulating hot water or steam through the jacket of the mixer. When complete homogeneity has been achieved, cooling is brought about by the circulation of cold water through the jacket of the mixer. The resultant dough can be broken up to give the large surface area required by simply reversing the stirring mechanism. The broken mass, ejected into trays, is dried until free from solvents and is finally ground to the required size. It is stated, however, that it is difficult to control the size of the granules produced by this process and large proportions of fines result.

Where this is undesirable, another method of granulation is described. In this method the gel is broken into smaller pieces and is fed into a screw stuffer and discharged through small orifices in the form of ribbons. These can be dried out and passed through grinders or cut into small granules as they emerge from the stuffer. Undesirable cohesion of the mass during the drying or seasoning process, or during passage through the stuffer, is prevented by keeping the temperature below the solution temperature. Normally, it is stated, seasoning can be begun around 75 degrees C. and the temperature can be gradually increased as the volatile ingredient is removed. The solvent content is usually reduced to less than 0.2 per cent. by the seasoning process.

Yet another modification is also described in this interesting patent. It is to actually add the ingredients directly to the screw stuffer, thus eliminating the use of the dough mixer. The ingredients are then homogenized in the stuffer itself and finally extruded as ribbons to be broken up as before. However, there is said to be a danger of incomplete homogenization in this latter procedure, particularly if colour has also to be thoroughly dispersed. The hot-acting solvent usually consists of a mixture of solvent and non-solvent, such as alcohol and water mixtures. Some examples of the composition used in this process are given in Table 1, which also serves to show some of the types of commercial cellulose-acetate moulding powder formulæ.

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(1) *Baker Perkins Inc., U.S.A.* (2) *Adamson United Co., U.S.A.* (3) *U.S.P.* 2,048,686 *and* 2,155,303 (*Eastman Kodak*, 1936 *and* 1939). (4) *U.S.P.* 2,150,939 (*Eastman Kodak*, 1939). (5) *U.S.P.* 2,319,040 (*Eastman Kodak*, 1943). (6) "*Modern Plastics*," 1947/24/137. (7) *Hungerford Plastics Corpn., Murray Hill, N.J., U.S.A.* (8) *U.S.P.* 1,953,956 (*H. Dreyfus*, 1934). *U.S.P.* 2,265,303 (*Celanese Corpn.*, 1941). (9) *U.S.P.* 2,419,035 (*Dupont*, 1947).

POWER TRANSMISSION BELTS

A new plastic coating for use on rubber or cotton power transmission belting has been announced by the Amercoat Division of the American Pipe and Construction Co., Los Angeles, California. The new material combines the properties of synthetic rubber with the chemical resistance of vinyl resins. The new coating will stand up to continuous flexing. It is said to have excellent adhesion to rubber, canvas, metal, concrete and wood, after the respective surfaces have been properly prepared, and has been recommended for conveyor and other belting which is subject to abrasion and spillage of oil, grease or chemicals.

BRITISH STANDARDS YEAR BOOK

Year Book 1948 of the British Standards Institution, which has just been published, gives a subject index and a synopsis of each of the 1,400 British Standards now current. These standards have been prepared by representative committees of 50 different industries. The book includes lists of members of the General Council, the Divisional Councils and the Industry Committee of the Institution, as well as other information about its work. Copies can be obtained from the Publications Sales Department, British Standards Institution, 24, Victoria Street, London, S.W.1, price 3s. 6d., post free.

World's Industry Employs Plastics.

GENERAL ENGINEERING

Machine tools.—A tap holder newly introduced by Burg Tool Mfg. Co., 5028 W. Jefferson Blvd., Los Angles 16, is separated from the machine spindle by a bonded neoprene disc, thus giving the effect of a flexible coupling. The new tool holder is said to prevent binding and absorbing shocks; it maintains taps on centre, and permits them to follow the hole. (" Modern Machine Shop," 1948/Feb./258.)

Clamp support.—Plastic clamp supports for the mounting of wires, cables, tubes, etc., are excellent insulators and are not affected by atmospheric conditions. (" Scientific American," 1948/Jan./35.)

Hardness testing.—The Rex hardness gauge for rubber and similar materials is no larger than a fountain pen. It is pressed against the surface to be tested, and the indicator holds its reading when the pressure is released. (" Scientific American," 1948/Feb./84.)

Glass cloth laminates.—Greater impact strength has been given to the thin trailing edge of metal elevators of transports by substituting fiberglas cloth laminates for the previously used aluminium alloy. (" Products Engineering," 1948/Feb./156.) A survey of plastic tooling by L. Wittman deals with cost comparisons and application possibilities of fiberglas tooling laminates. The average moulded laminate can be manufactured in 60 per cent. less time than equivalent tool steels. (" Tool and Die Journal," 1948/13/55.)

Standard Specifications.—G. Ehlers reports on the establishment of several subcommittees of the German Standards Association (D.N.A.) for dealing with plastics: (1) Classification, designations (Dr. Heering); (2) typisation and properties of thermoplastic moulding materials (Dr. Nitzsche); (3) preparation for typisation of thermoplastics (Dr. Schwarz); (4) testing methods (Dr. Vieweg); (5) finished plastic components (Dr. Greinert); (6) plastic bearings (Dipl. Ing. Hobein); (7) moulding and die-casting dies (Turnwald); (8) glues and cements; (9) artificial leather (Dr. Krueger); (10) plastic foils (Dr. Roehm); (11) semi-finished laminated materials (Dr. Wandeberg); (12) plastic pipelines and profiles (Dr. Scholz). (" Kunststoffe," 1947/July/160.)

Mechanical testing.—New testing machines of 60,000 and 120,000 lb. capacity, by Baldwin Locomotive Works, are said to have been specially developed for determining the physical properties of plastics in tension, compression, or flexure, over a range of temperature of minus 70 to 170 degrees F. (" Scientific American," 1948/Feb./76.)

MISCELLANEOUS

Spectacles.—Lightweight, plastic safety spectacles are so designed that they fit over all types of eyeglasses, including those of the widest patterns. A moulded frame is provided; the lenses are of shatterproof " Impax." (" Machine and Tool Blue Book," 1948/Jan./251.)

Sealing metal cans.—The American Can Co. is now using thermoplastic seals in place of solder on the side seam of cans. A further improvement is a

closure which can be resealed after opening. The sealing gasket is made of paper impregnated with a wax and a thermoplastic resin. ("Scientific American," 1948/Jan./34.)

Embossing.—An embossing technique has been developed for acrylics and other thermoplastics with the use of a new casting material, "Ceramite." (Furane Plastics and Chemical Co.) It is carried out in three steps: A clay model is provided with the design, "Ceramite" is powdered over and allowed to set and cure, the warmed thermoplastic sheet is pressed with a rubber pad against the casting. ("Scientific American," 1948/Jan./29.)

Gas pipe.—Cellulose acetate butyrate tubing is being used to replace steel gas pipe. The Southern California Gas Co. has made about 500 installations, consuming about 40,000 ft. of plastic tubing. ("Scientific American," 1948/Jan./31.)

Bases for Plastics.—Dr. A. M. Paquin reports investigations on urea and sulphamides as bases for plastics; high quality softeners and glycerine substitutes can be produced. ("Kunststoffe," 1947/Aug./165.)

Hard rubbers.—W. S. Bishop describes synthetic hard rubbers and their testing during the war years, when used for hard rubber components by The Bell Telephone Co. ("Bell Laboratories Record," 1948/Feb./55.)

Blown Acetate.—Recommendations for the blowing of cellulose actate are given in an answer to a reader's query (Practical Engineering," 1948/March 5/196.) The use of a split mould after the blanks have been cut out, is recommended.

Laminates.—Technical developments concerning plastics and rubber, including reference to modified styrenes and laminates, as also production methods, receive editorial comment in ("Products Engineering," 1948/Feb./114.)

Radar.—U.S. Navy fire control antenna contains an array of polystyrene rods. It has been developed by Bell Telephone Laboratories, and consists of 14 identical fixed elements. ("Products Engineering," 1948/Feb./148.)

Optical stress.—E. Monench surveys the frozen stress method for optical investigations. The accuracy of the tests was formerly insufficient owing to the edge effects which caused over stress. By application of a protecting shell of aluminium foil this can be avoided, whereas the optical effect has been increased to about the threefold value by suitable heat treatment. ("Kunststoffe," 1947/Sept./181.)

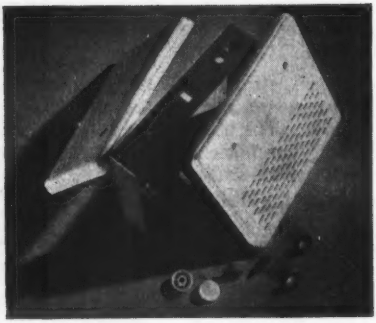
Adhesive standards sponsored by the American Society for Testing Materials have been compiled in a 50-page brochure. Some test methods given are still tentative; three methods for rubber adhesives are included. (A.S.T.M., 1916, Race Street, Philadelphia 3, Pa.)

Welding p.v.c.—Soft polyvinyl chloride commences to melt at 170-200 degrees C. without becoming fluid, and in this state welds without pressure. P. Voigt, in a well-illustrated article, describes methods and equipment. ("Kunststoffe," Vol. 37, 1947/Oct.-Dec./210.)

Oil-resistant coating.—New phenolic resin coating material can be cured without heat or pressure. One special application is to make other plastics, e.g., bottles or caps, resistant to oils or solvents. ("Chemical Engineering," 1947/Dec./184.)

Mar-resistant surface.—A new treatment referred to as "Logoquant" (Bee Chemical Co., Chicago), is said to provide mar resistant surfaces on low-cast polystyrene. It is applied by dipping or spraying with usual equipment, the time of treatment being 15 min. The resulting mar resistance is 18 per cent. higher than that of the untreated material. ("Machinery," New York, 1948/Feb./174.)

Testing.—Present-day problems in the testing of plastics are treated by R. Vieweg. ("Kunststoffe," 1947/July/152.) The present situation in Germany shows great demand for goods of every kind.



NEW PORTABLE RADIO

Highly Commendable Achievement by E. K. Cole, Ltd.

RADIO engineers and designers set the "Ekco" plastics division a problem in their new Princess portable receiver. The plastics answer is one of the most satisfactory and attractive products of the industry, which may well indicate a new trend. Certain fundamentals in the "Ekco" conception of their latest portable had to be met by the company's plastics division:—

1. The receiver had to be compact and light.
2. It had to be colourful and stylish to achieve the personal appeal.
3. The material had to be virtually unbreakable.
4. The material had to be unaffected by varying weather conditions.
5. The material had to be pleasant to handle.

E. K. Cole, Ltd., chose cellulose acetate butyrate as the ideal material. Its colour possibilities are unlimited; it is unaffected by either tropical or arctic conditions; it is lightweight; and the finished moulding is resilient.

Taking full advantage of the injection moulding technique, now a strong feature of the company's plastics development, E. K. Cole are moulding the main frame and sides of the case on 9-oz. H.P.M. machines—the knobs, with their brass

screw inserts, and the wavechange switch on 2-oz. Daniels machines. The tools themselves were designed and fabricated in the company's recently extended toolroom. In spite of the 95 small perforations on each side, forming the speaker fret, this moulding is being produced substantially flat owing to careful tooling, and no deflashing is necessary after pressing. Both sides and frame are entirely free from blemishes or flow marks, often associated with the use of self-colours. The general advantages of a thermoplastic over a phenolic material for this unique radio case are apparent in almost every feature. It is particularly interesting to note that the total weight of the mouldings is only 12½ oz.

The styling of the "Ekco" Princess portable (model P63) is the work of Wells Coates, R.D.I.; the plastics technical designing was undertaken in E. K. Cole's own industrial design studios at South-end-on-Sea.

A retractable clear "Perspex" carrying handle and an extruded shoulder strap and plastics buckle in colours matching the case complete this all-plastics contribution to the radio industry.

British Industries Fair, 1948

Pre-view of Exhibits in the Plastics Section

THE second post-war British Industries Fair opens in London and Birmingham on May 3. The London Section will be held at Earls Court and Olympia; the Birmingham Section at Castle Bromwich. Both Sections of the Fair remain open until May 14.

As last year, the plastics exhibits will be at Earls Court, but on this present occasion on the ground floor, the stand numbers concerned being prefixed by the letter Q. Here a total of 68 firms are to be represented, of which about 30 per cent. are newcomers to the Fair. For the convenience of our readers we give in this issue an analytical summary of the exhibitors in the Plastics Section, indicating the general nature of the goods to be shown; also a plan of this section to assist in locating any particular stand. A full report of the Fair, including those portions at Castle Bromwich which are of interest to the plastics industry, will be published in our issues for May and June.

The British plastics industry is now producing upwards of 85,000 tons of material a year; the value of its products is said to be in the neighbourhood of £60 million. Even if our figures are questionable, the far-reaching extent of the industry is clearly indicated with some 60,000 persons actually employed, which, on that count alone, shows a four-fold expansion on the pre-war figures.

According to a recent comment in the "City Observer," from which we quote the foregoing statistics, adhesives take 10 per cent. of the plastic raw materials actually consumed in Britain; protective coatings take 35 per cent.; laminates and paper and textile treatment 10 per cent.; films, sheets, safety glass and like products 20 per cent.; the balance (25 per cent.) going to the moulding industry.

The 1948 Fair will include a number of developments which are new to the British plastics industry. Rigid sheet produced from vinyl copolymer resins will be shown for the first time. The principal uses for this "Vybak" sheet, exhibited by Bakelite, Ltd., are in the construction of scientific instruments, slide rules, bookbinding, etc.; there is also likely to be a notable outlet in the packaging industry. Although "rigid" when compared with normal p.v.c. sheeting, these new "Vybak" plastics are readily flexible down to curves of less than an inch radius. Sheets will be shown in thicknesses from 0.01 in. to 0.125 in., with a range of translucent and opaque colours, as well as the clear transparent form.

Extrusions in rigid vinyls for ship fitments, and the use of polythene for household plumbing, will be featured by Tenaplas, Ltd., who are endeavouring to stress the pronounced tendency for using extruded thermoplastics much more widely in industrial appliances. They will be showing extruded pipes and ducts which claim to have higher finish and greater precision than the products of any foreign competitors.

A very recent development to be demonstrated by Vinyl Products, Ltd., concerns their "Vinamold" hot melt compounds for the repetition production of plaster and cast resin mouldings, and for use as a protective coating for tools and metal components. Reference to the production of flexible moulds by use of these compounds has already appeared in "Plastics" (March, 1948). Vinatex, Ltd., an associated company, is exhibiting p.v.c. sheeting in the Textiles Section of the Fair.

In the matter of laminates, De La Rue Insulation, Ltd., will be laying emphasis on the particular qualities of "Formica," which is now manufactured in this country under licence from the Formica Insulation Co., of Cincinnati, Ohio; prior to the erection of the new De La Rue factory on Tyneside, this decorative

Exhibitor	Stand No.	*Raw materials for moulding						Finished or semi-finished				
		Casein	Phenolics	Urea	Cellulose Plastics	Vinyl	Polythene	Mouldings	Laminates	P.V.C. Sheet	Fabrication from Acrylic and Acetate Sheet	Extrusions
Airfix Products, Ltd.	Q.31	—	—	—	—	—	—	X	—	—	—	—
Andover Plastics, Ltd.	Q.27	—	—	—	—	—	—	X	X	—	—	—
Arlington Plastics Development, Ltd.	Q.3	—	—	—	—	—	—	—	—	X	—	—
Ashdowns, Ltd.	Q.35	—	—	—	—	—	—	X	X	—	X	—
B.I.P. Tools, Ltd.	Q.36	—	—	—	—	—	—	—	—	Moulds and tools		
BX Plastics, Ltd.	Q.15	X	—	—	X	X	—	—	—	X	—	X
Bakelite, Ltd.	Q.9	—	X	—	—	X	—	—	X	—	—	X
Barclay-Stuart (Plastics), Ltd.	Q.45	—	—	—	—	—	—	X	—	—	—	—
Beetle Products Co., Ltd., Beetle Bond, Ltd.	Q.36	—	—	X	—	—	—	—	—	—	—	—
Blewis and Shaw (Plastics), Ltd.	Q.8	—	—	—	—	—	—	X	—	—	—	—
British Artid Plastics, Ltd.	Q.7	—	—	—	—	—	—	X	—	—	—	—
British Celanese, Ltd.	Q.28	—	—	—	X	—	—	—	—	—	—	X
British Ebonite Co., Ltd.	Q.59	—	—	—	—	—	—	X	—	—	—	X
British Geon, Ltd.	Q.48	—	—	—	—	X	—	—	—	X	—	X
British Industrial Plastics, Ltd.	Q.36	—	—	X	—	—	—	X	—	—	—	—
British Moulded Plastics, Ltd.	Q.26	—	—	—	—	—	—	X	—	—	—	—
British Mouldex Rubber Co., Ltd.	Q.33	—	—	—	—	—	—	X	—	X	—	X
British Resin Products, Ltd.	Q.50	—	X	X	X	—	—	X	X	—	—	X
Cables and Plastics, Ltd.	Q.54	—	—	—	—	—	—	X	—	—	—	X
Catalin, Ltd.	Q.44	—	X*	X	—	—	—	X†	—	—	—	—
E. K. Cole, Ltd.	Q.55	—	—	—	—	—	—	X	—	—	—	—
P. B. Cow and Co., Ltd.	Q.14	—	—	—	—	—	—	—	X	X	—	—
Crystalate, Ltd.	Q.43	—	—	—	—	—	—	X	—	—	—	—
Dalebrook, Ltd.	Q.11	—	—	—	—	—	—	—	—	X	—	—
De la Rue Insulation, Ltd.	Q.52	—	—	—	—	—	—	—	X	—	—	X
Dufay-Chromex. Ltd.	Q.57	—	—	—	X	—	—	—	X	—	—	—
Duraplex (Plastics), Ltd.	Q.47	—	—	—	—	—	—	—	—	X	—	X
Duratube and Wire, Ltd.	Q.11	—	—	—	—	—	—	—	—	—	—	X
Ebonestos Industries, Ltd.	Q.43	—	—	—	—	—	—	X	X	—	—	—
F. E. Edmunds	Q.2	—	—	—	—	—	—	X	—	—	—	X
Erinoid, Ltd.	Q.38	—	—	—	—	—	—	—	X	X	—	X
Expanded Rubber Co., Ltd.	Q.34	—	—	—	—	—	—	—	X	—	—	—
Fraser and Glass, Ltd.	Q.5	—	—	—	—	—	—	X	—	—	—	X
G.P.A. Plastics, Ltd.	Q.12	—	—	—	—	—	—	X	—	X	—	—
Grantham Plastics, Ltd.	Q.16	—	—	—	—	—	—	X	—	—	—	—
Hill, Norman and Beard Plastics, Ltd.	Q.58	—	—	—	—	—	—	X	X	—	—	—
Holoplast, Ltd.	Q.21	—	—	—	—	—	—	—	X	—	—	—
I.C.I. (Plastics), Ltd.	Q.42 Q.49	—	X	X	—	X	X	—	—	X	X	X
Injection Moulders, Ltd.	Q.46	—	—	—	—	—	—	X	—	—	—	—
Insulators, Ltd.	Q.39	—	—	—	—	—	—	X	—	—	—	—
Lacrinoid Products, Ltd.	Q.27	—	—	—	—	—	—	X	—	—	X	—
Marberry Products, Ltd.	Q.17	—	—	—	—	—	—	X	—	—	X	—
Mentmore Manufacturing Co., Ltd.	Q.41	—	—	—	—	—	—	X	—	—	—	—
Merlin Mouldings, Ltd.	Q.40	—	—	—	—	—	—	X	—	—	—	—
Metropolitan Plywood Co., Ltd.	Q.53	—	—	—	—	—	—	—	X	—	—	—
Mica Products, Ltd.	Q.43	—	—	—	—	—	—	X	X	—	—	—
North British Plastics, Ltd.	Q.32	—	—	—	—	—	—	—	X	—	—	—
P.A. Permuta (Plastics), Ltd.	Q.13	—	—	—	—	—	—	X	—	—	—	—
Plasticraft, Ltd.	Q.24	—	—	—	—	—	—	X	—	—	X	—
Plastic Materials, Ltd.	Q.18	—	—	—	—	—	—	—	—	X	—	—
G. Read and Co. (Hackney), Ltd.	Q.19	—	—	—	—	—	—	X	—	—	—	—
Runcolite, Ltd.	Q.56	—	—	—	—	—	—	—	X	—	—	X
Simco Plastics	Q.30a	—	—	—	—	—	—	—	—	X	—	—
Stanley Smith and Co.	Q.51	—	—	—	—	—	—	—	X	X	—	X
Spicers, Ltd.	Q.23	—	—	—	—	—	—	—	X	X	—	—
Stadium, Ltd.	Q.29	—	—	—	—	—	—	X	—	—	—	—
Splintex Safety Glass, Ltd.	Q.25	—	—	—	—	—	—	—	—	—	X	—
Sterling Moulding Materials, Ltd.	Q.37	—	X	X	X	X	—	—	—	—	—	—
Sterling Plastics, Ltd.	Q.37	—	—	—	—	—	—	X	—	—	—	—
Stone and Simmons	Q.3a	—	—	—	—	—	—	—	—	—	X	—
Streetly Manufacturing Co., Ltd.	Q.36	—	—	—	—	—	—	X	X	—	—	—
Tenaplas. Ltd.	Q.20	—	—	—	—	—	—	—	X	—	—	X
Thermo-Plastics, Ltd.	Q.10	—	—	—	—	—	—	X	X	—	X	—
Universal Plastics, Ltd.	Q.6	—	—	—	—	—	—	X	—	—	—	—
Utilex, Ltd.	Q.38	—	—	—	X	—	—	—	—	X	—	—
Vinyl Products, Ltd.	Q.1	—	—	—	—	X	—	—	—	X	—	—
Wokingham Plastics, Ltd.	Q.12	—	—	—	—	—	—	X	—	—	X	—

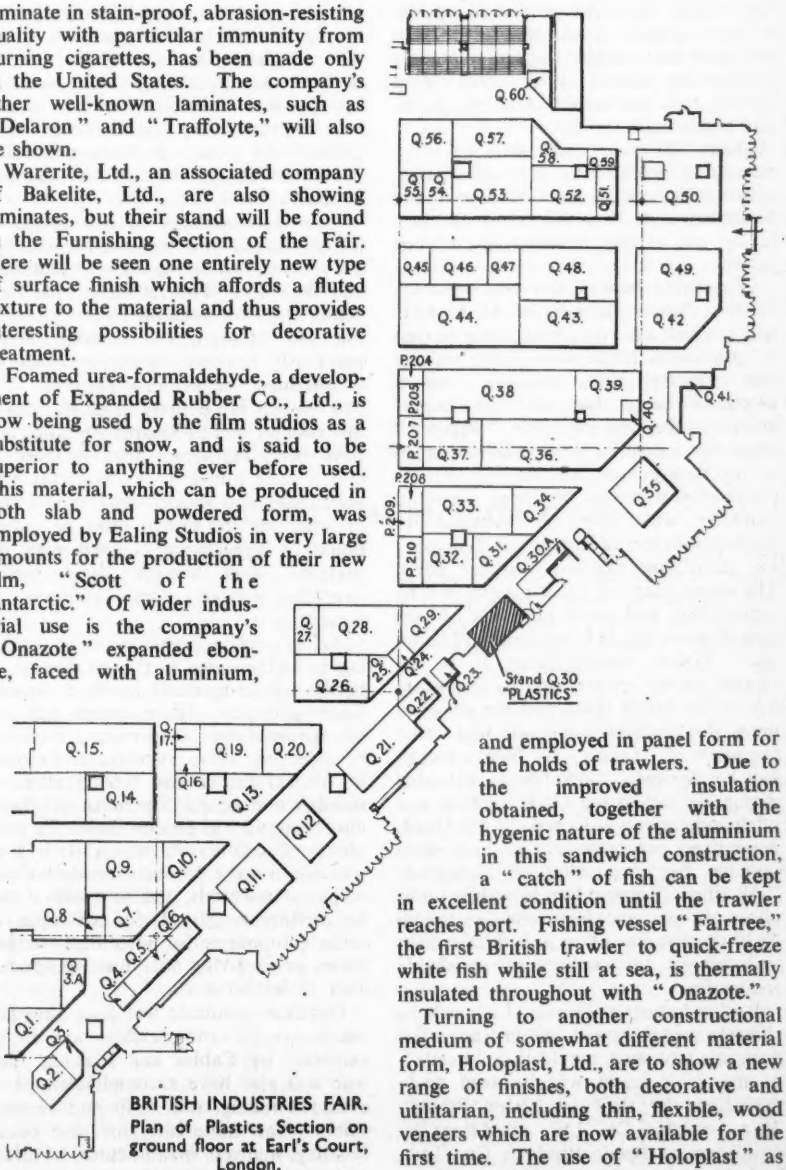
* Including phenolic glues. † Phenolic castings.

laminate in stain-proof, abrasion-resisting quality with particular immunity from burning cigarettes, has been made only in the United States. The company's other well-known laminates, such as "Delaron" and "Traffolyte," will also be shown.

Warerite, Ltd., an associated company of Bakelite, Ltd., are also showing laminates, but their stand will be found in the Furnishing Section of the Fair. Here will be seen one entirely new type of surface finish which affords a fluted texture to the material and thus provides interesting possibilities for decorative treatment.

Foamed urea-formaldehyde, a development of Expanded Rubber Co., Ltd., is now being used by the film studios as a substitute for snow, and is said to be superior to anything ever before used. This material, which can be produced in both slab and powdered form, was employed by Ealing Studios in very large amounts for the production of their new film, "Scott of the Antarctic." Of wider industrial use is the company's "Onazote" expanded ebonite, faced with aluminium, and employed in panel form for the holds of trawlers. Due to the improved insulation obtained, together with the hygenic nature of the aluminium in this sandwich construction, a "catch" of fish can be kept in excellent condition until the trawler reaches port. Fishing vessel "Fairtree," the first British trawler to quick-freeze white fish while still at sea, is thermally insulated throughout with "Onazote."

Turning to another constructional medium of somewhat different material form, Holoplast, Ltd., are to show a new range of finishes, both decorative and utilitarian, including thin, flexible, wood veneers which are now available for the first time. The use of "Holoplast" as acoustic panelling for the construction of telephone kiosks will be demonstrated



BRITISH INDUSTRIES FAIR.
Plan of Plastics Section on ground floor at Earl's Court, London.

and is likely to be of considerable interest to the acoustic specialist. During the past year the greater proportion of production has passed to the shipbuilding industry for use as bulk-heading, panelling and interior finish.

Dufay-Chromex, Ltd., will have an interesting exhibit of "Dufaylite," with which they hope to include some of the development work which is taking place in the use of this material for aircraft wings.

The theme behind this year's display by the Plastics Division of I.C.I., Ltd., will concern the parts now being played by plastics in modern industry, both in this country and overseas, special emphasis being laid on the export market. The use of clear "Perspex" sheet for industrial safety devices, such as machine guards and screens, will be exemplified by actual instances. A small machine will also be installed to demonstrate the advantages of "Perspex" for protecting exposed working parts. The entire range of I.C.I. plastics will be represented, and many examples of fabricated goods made from them will be on view. Nylon monofilament is to be singled out for display and its important use in the brush trade and the development of a continuous monofil, sold under the name of "Luron" for fishing tackle, will be stressed. "Alkathene" extruded piping for use in the food, brewing and other industries will be seen at this stand. An entirely new technique has now made possible the production of high-grade "Alkathene" plastic film in widths up to about 48 ins., and from one-thousandth to 10-thousandths of an inch thick, which will interest the packers of perishable foodstuffs.

British Industrial Plastics, Ltd., will be showing an increased colour range for domestic tableware moulded in "Beetle"; at the same stand will be seen trade mouldings by their associates, Streetly Manufacturing Co., Ltd., mouldings by customers of Beetle Products Co., Ltd., and selected moulding in "Beetle Melamine." Here a wide variety of goods is to be exhibited, virtually ranging from toothpaste cap to radio cabinet, and a notable proportion of space will be devoted to packaging and electrical applications. A selection of urea mouldings carrying heavy inserts should be of interest to the electrical industry. Moulds, tools and dies will be featured by B.I.P. Tools, Ltd.

New developments in the design of p.v.c. profiled and embossed extrusions are to be shown on the stand of Duratube and Wire, Ltd. This refinement has been achieved by considerable research carried out on "Durastrip" material, which previously has been decorated only by longitudinal ridges and patterns. The new designs are entirely original, both in this country and as regards America, and have been registered; they promise to find a wide outlet in the fabrication of belts, bags and shoes, and for novelties, or wherever the design must be exceptional in appearance coupled with the material itself having great tensile strength, elasticity and lightness in weight.

An interesting development by British Geon, Ltd., relates to the production of hard vinyl compounds based on special Geon polymer. These compounds can be moulded by compression, extrusion or injection, using standard techniques, to form rigid articles having excellent stability and general chemical resistance. On this stand will also be shown the wide range of colours in which it is now possible to make products based on Geon polyvinyl materials, and how colour can be usefully employed, for example, in cable compounds for identification purposes, or in giving an attractive appearance to leathercloths.

Polythene insulated and p.v.c.-sheathed electric cables and flexibles are to be exhibited by Cables and Plastics, Ltd., who will also have a complete range of extruded tubing, rod, strip and sections suitable for motorcar, bus and coach building, mattress manufacture, furniture making and for handbags, belts and braces.

Printed cellulose acetate and p.v.c. sheeting not previously exhibited will be seen at the stand of Spicers, Ltd.

Religious ornaments, cast in phenolic resins and hand-finished to achieve accuracy in detail, with an appearance closely approaching that of hand-carved ivory or stone, will be featured by Marberry Products, Ltd., who point out that the market in this class of goods has for so many years been held almost exclusively by Czechoslovakia, France and Italy. Among novelties, Dalebrook, Ltd., who are manufacturers of plastic artificial flowers, are to exhibit a collapsible plastic Christmas tree.

Articles which have been fabricated from "Perspex" for use of the catering trade will be seen at the stand of Thermo-Plastics, Ltd.; also a range of sanitary fittings in acrylic material. "Perspex" lavatory basins, machine guards, road signs and lighting reflectors will be displayed by Splintex Safety Glass, Ltd. Fabrications in laminated plastics by Hill Norman and Beard Plastics, Ltd., are to make a special challenge to foreign competition by the fact that all the goods shown are sold flat for ease of packing and transport; tables and other articles of furniture are to be included.

Stone and Simmons will be showing the adoption of polystyrene for the production of lightweight tableware with stain-resisting qualities. Airfix Products, Ltd., are to include an achievement in injection moulding, as regards large surface area and thin-wall measurement, in the shape of display packing boxes made of polystyrene.

Exhibits at Castle Bromwich

A NUMBER of exhibits in the Engineering and Hardware Section of the B.I.F. at Castle Bromwich will be of plastics interest. They fall under the heading of presses, radio frequency equipment for the welding of p.v.c., the spraying of polythene, and plastic mouldings and laminates which find their principal outlet in the engineering and building industries.

Bradley and Turton, Ltd. (D.239) are exhibiting their 100-ton semi-automatic press with self-contained pumping unit. Injection moulding will be shown in operation at the stand of Alfred Herbert, Ltd. (D.310), who will also have hydraulic presses for die hobbing and preforming. Other exhibitors of plastics machinery are Finney Presses, Ltd. (D.140), T. H. and J. Daniels, Ltd. (D.216) and E.M.B. Co., Ltd. (D.134).

Equipment for the radio frequency welding of p.v.c. and other thermoplastics will be shown by Delapena and Son, Ltd. (D.234), Radio Heaters, Ltd. (C.221) and E.M.I. Factories, Ltd. (C.516). These exhibitors will include an extensive range of preheaters and seam welders for thermoplastic sheet. Schori Metallising Process, Ltd. (D.524), will have a working demonstration of plastic spraying and a display of chemical plant with sprayed plastic coatings as a protection against attack by acids. Tungsten carbide-tipped tools will be seen at the stands of Protolite, Ltd (D.247) and A. C. Wickman, Ltd. (D.416).

Among other exhibitors of plastics interest are Ashdowns, Ltd. (C.105), silicone-bonded glass cloth for high-temperature electrical insulation; Bakelite, Ltd. (C.404), moulding materials, laminates and "Vybak" insulation; Birkbys, Ltd. (C.307), moulding powders and mouldings; Evered and Co., Ltd. (B.327 and 226), builders' hardware in "Everite" plastics; Ferodo, Ltd. (D.733), plastics for aircraft and other industries; Glostics, Ltd. (D.500), hot dip protective plastic coating for packaging metal parts; Ioco, Ltd. (D.701), laminated plastics.

In answer to J. Crabtree (Blackpool) and other inquirers, Barlow-Whitney, Ltd., Coombe Road, London, N.W.10, are the manufacturers of the electrically heated container illustrated in "Plastics," March, 1948, page 114.

Number Wheels and Pinions of Polystyrene

THE selection of a suitable material for the casting of number wheels and pinions employed in special-purpose counting instruments has called for no small amount of research and experiment. Direct-reading meters for electricity, gas and water demand a high degree of precision in respect of the clockwork design and assembly, but additionally, each type calls for individual consideration in relation to the conditions under which it is operated and has to be maintained in working order.

The materials generally employed for the casting of number wheels and pinions in counting mechanisms are high-grade tin alloy, and polystyrene ("Trolitul"). Although either of these materials may be used satisfactorily, there are, nevertheless, conditions in which one or the other material is definitely indicated.

Those who customarily handle counting instruments will be familiar with the number wheel and pinion which is cast in high-grade tin alloy, and with the many excellent qualities possessed by this material. The advantages of polystyrene, however, are not so widely known, even for accurate comparison to be made. Its use in this connection is in no way untried or of experimental nature. Under the name of "Trolitul," polystyrene was employed on the Continent for some years prior to 1939. The high degree of skill needed in the designing of dies for wheels and pinions, and in the moulding and finishing processes, however, has now brought manufacture in this country peculiarly within the province of the firm specializing in these matters.

The advantages of the polystyrene wheel and pinion—within certain limitations of operating and maintenance conditions to be specified later—fall under three headings: (1) physical, (2) practical, (3) economical.

PHYSICAL.—Polystyrene is practically non-hygroscopic, a widely representative range of samples giving as little as 0.004 per cent. water distortion/length change after twenty-one days' immersion in

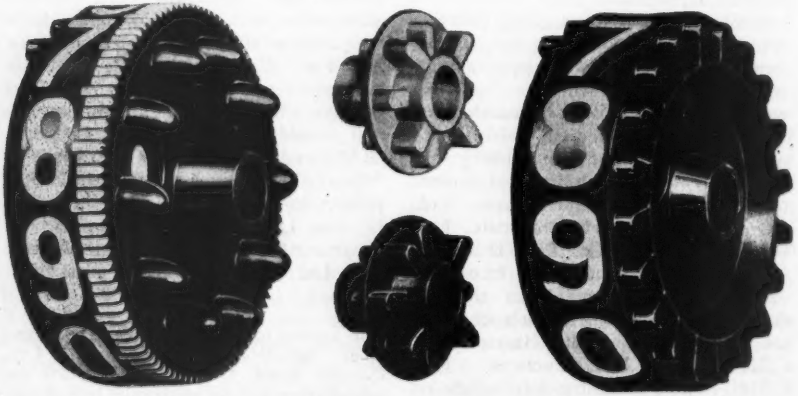


Fig. 1.—Typical number wheels and pinions of "Trolitul" (polystyrene), as made by The H. J. Thormann Engineering Co., Ltd.

Table 1.

Type of meter	Method of cleaning	Temperature 122°F./50°C.	Conditions of use: wet or dry	Material to be used for number wheels and pinions
Electricity	Benzine	Immaterial	Immaterial	Tin base alloy
Electricity	No benzine	Above 50°C.	Immaterial	Tin base alloy
Electricity	No benzine	Below 50°C.	Dry	Tin base alloy or polystyrene
Electricity	No benzine	Below 50°C.	Wet	Polystyrene
Gas	—	Above 50°C.	Immaterial	Tin base alloy
Gas	—	Below 50°C.	Dry	Tin base alloy or polystyrene
Gas	—	Below 50°C.	Wet	Polystyrene
Water	—	—	Wet	Polystyrene

water. The specific gravity is 1.07. The co-efficient of friction is extremely low, and the material is non-corrosive.

PRACTICAL.—Apart from the qualities which enable number wheels and pinions to be cast and finished with the highest degree of accuracy demanded by these instruments, polystyrene is attractive in appearance and permits of colour combinations in the wheels to give a maximum of contrast value and, hence, legibility. For example, decimal or other fractional units can be read in, say, red figures on a white wheel, while the main units are in white figures on a black wheel.

ECONOMICAL.—The price for number wheels and pinions in polystyrene is considerably lower than for corresponding parts cast in tin-base alloy. This is due not only to the slightly lower price of the plastic, but also to the fact that approximately five times as many castings can be made from one unit of polystyrene as from one unit of tin-base alloy.

From the foregoing remarks it might be concluded that the claims of polystyrene as a material for the casting of number wheels and pinions would admit little challenge, if any, yet there are certain factors which must be taken into consideration before deciding to employ this material.

The first of these factors is temperature. For example, it is found that polystyrene will not give satisfactory service under prolonged temperature conditions in excess of 122 degrees F. (50 degrees C.); account must therefore be taken of climatic as well as local conditions in which the counting instrument is to be operated.

A second factor to be considered represents no inherent disability in polystyrene itself, but arises from the custom widely adopted in some countries of cleaning the clockwork assembly of electricity meters by immersing the entire mechanism (including number wheels and pinions) in benzine. Polystyrene, being soluble in benzine, is therefore contra-indicated where the prospective user insists upon this method of cleaning. However, as benzine immersion is not employed in the cleaning of gas and water meters, this limitation applies only to electricity meters.

Referring again to the physical properties of polystyrene it will be recalled that this material is non-hygroscopic. Accordingly, if the meter is to be located in a damp or wet place the use of polystyrene number wheels and pinions in preference to tin-base alloy is essential, since wet conditions would tend to cause corrosion where tin is used. These conditions are expressed in Table 1.

It will be observed that subject to certain limitations as to temperature and method of cleaning, the polystyrene number wheel and pinion offers advantages which will commend themselves to those specializing in the manufacture and assembly of counting instrument mechanism. They are already being manufactured on a large scale by The H. J. Thormann Engineering Co., Ltd., of 5, Elstree Way, Boreham Wood, Herts, in conformity with the high standards demanded for accuracy and free-running.

LETTERS TO THE EDITOR

Correspondents are reminded that a stamped and addressed envelope should be enclosed in all cases where a personal answer is desired. It is understood that any letter received may be published at the discretion of the Editor.

Brush Backs

Sir,—We read with interest your editorial on "Brush Backs," in the March issue of "Plastics. We have, ourselves, been trying for two or three years to obtain some brush handles made in plastic material, but up to the time of writing we have still not succeeded. As one of the largest brush makers in the country, we realize the disadvantage of using wood, and with an eye to the future we have endeavoured to obtain a more modern material, but without success. If any of your readers are in a position to mould brush handles we shall be very glad to hear from them.

With regard to the question of making vacuum-cleaner brushes with a plastic base, this is out of the question with most types of plastic as the bristles are fixed in with a staple which would not pierce the former as it would in wood. Of course, we appreciate that it is possible to use, for example, polythene, which, we believe, would hold the staple quite well, but it does require some experimental work to be carried out before one can satisfy oneself that it is, or is not, possible.

BETTERWEAR PRODUCTS, LTD.
North Street,
Romford, Essex.

"Marco" S.B. Resins

Sir,—In your issue of November last an article appeared by Mr. Wentworth Weekes dealing with "Polyesters as Casting Resins," but the writer made reference to availability in the United Kingdom as being dubious.

We would, therefore, like to point out that manufacture of our "Marco" range of polyester resins is now commencing at our Wollaston (Northamptonshire) works and supplies are available for immediate delivery.

Marco resins are eminently suitable for casting purposes in addition to laminating and impregnating and were developed by Dr. Maskat in the U.S.A. after he had evolved the CR.39 resin for the Pittsburgh Plate Glass Co., to whom Mr. Wentworth Weekes makes reference as pioneers.

SCOTT BADER AND CO., LTD.
109, Kingsway,
London, W.C.2.

Protection Against Corrosion

Sir,—Reference to the above subject matter, we note in the February issue of "Plastics" the letter from A. A. Jones and Shipman, Ltd.

It would appear that A. A. Jones and Shipman, Ltd., have been trying for some time to obtain a "skin" protection for their small tools, etc., and have been informed that ethyl cellulose was not being produced for this purpose in this country. May we draw your attention to the fact that Courtaulds, Ltd., are producing ethyl cellulose, and, to the best of our knowledge, are the only firm in this country producing this material; also, we are making available compounds for protective coating.

COURTAULDS, LTD.,
Coventry. Plastic Division.

Evaluation of Solvents

Sir,—May we ask your general advice on the evaluation of a certain type of solvent of petroleum origin? We are merchants and have in mind a specific quality which before the war was stated to be higher in solvent power than "ordinary" white spirit. Any technical information would be gratefully received.

Liverpool. L. M. T.

[EDITOR'S NOTE: Presuming that this refers to a white spirit of boiling range 145-190 degrees C., we suggest the improvement is due to a certain benzol or similar ring-compound content. In the plastics industry, or rather in that section that produces solutions of resins and similar materials, and in the paint and varnish

industry; the use of such a material is generally only as a diluent and not as a true solvent. Therefore the evaluation consists roughly in the ability to use the white spirit and still produce stable solutions, to attain a prescribed viscosity, and so on. For example, compatibility with, say, metro-cellulose and cellulose acetate should be examined; that is, comparing the quantity of your white spirit necessary to cause precipitation from a standard solution of nitrocellulose in the usual solvents, with, say, Pool white spirit.]

Nylon Monofilament

Sir,—We should be very glad if you could help us by recommending a manufacturer of nylon monofilament suitable for use as bristles in the manufacture of toothbrushes, which we require for export. A. STERN.

London, S.E.1.

[EDITOR'S NOTE: I.C.I. (Plastics Division), Welwyn Garden City, Herts, are, so far as we know, the only producers of nylon monofilament.]

Cable-making Materials

Sir,—For increasing the resistance of cable-making materials to the attacks of termites and mould, we are at present using compounds prepared with pentachlorophenol and hexachlorocyclohexane. However, the staff of our laboratories complains about using these products, which develop most unpleasant fumes. Could you let us know whether such inconvenience has been experienced in England, and if these fumes are only unpleasant but not toxic?

LES CABLES DE LYON.

Lyon, France.

[EDITOR'S NOTE: Pentachlorophenol and hexachlorocyclohexane are both noxious materials, and especially at high temperatures, can prove dangerous to health. They are, of course, effective for the purpose mentioned, although the extent of their life in this connection is doubtful.

Depending on the raw materials employed, most specifications for structures sent to tropical climates have included the use of copper naphthenate or zinc naphthenate, which are widely used by many factories that have this same problem, as also by the Ministry of Supply, Admiralty, etc. These naphthenates are used for impregnating all fabrics, and it has even been suggested mixing copper naphthenate with polyvinyl chloride for cable sheathing. We believe that a patent covering the use of copper naphthenate has been taken out by Pirelli.]

Labels for Fruit Trees

Sir,—Is it possible to make small labels from plastics suitable for use on fruit trees? Such a label, which should be weatherproof, would be of great value to gardeners, large and small. F.B.

[EDITOR'S NOTE: Being enthusiastic gardeners ourselves, we have often wished some enterprising firm would market such a useful label. The main requirements are weatherproofness and legibility of wording, and, in our opinion, this can be obtained most readily by the use of the "sandwich" type of laminate made from two differently coloured "veneers." When one side is engraved to a sufficient depth, the other differently coloured sheet becomes visible as lettering. This general process is already carried out by certain engineering concerns, more especially for producing black electrical switchboards with engraved white lettering. This type can prove much superior to lead labels, which get dirty so quickly. Alternatively, transparent thermoplastics, such as polystyrene and polymethyl methacrylate, which are very water-resistant, may be used. In such cases the process might be simply to place a printed sheet of paper between two thin sheets of the plastic and then to cement the edges together. A similar method could be employed using a transparent flexible plastic of the vinyl type.]

Plastic Gauze

Sir,—An Australian customer tells us that a woven plastic mesh is being made in the United States similar to the normal flyproof woven wire gauze. They are asking whether anything of this type is being made in this country.

Liverpool. W.A.S. AND CO.

[EDITOR'S NOTE: Such gauzes can be made from monofilaments of several vinyl compounds, especially of the co-polymer type, and from nylon. The only British development we know of is "Tygan," recently introduced by Fothergill and Harvey, Ltd., 37, Peter Street, Manchester. The monofilament employed is "Bexan," evolved by BX Plastics, Ltd.]

Notes from the British Plastics Federation

New Members

The following have been elected to membership of the Federation:—

MOULDERS GROUP:

David Hughes (Leeds), Ltd.

FABRICATORS GROUP:

B. and G. Plastics, Ltd.

Bowen Prize Fund

The Council of the British Plastics Federation, as administrators of the Bowen (Cables and Plastics) Prize Fund, offer three prizes, to the value of £50 each, for award in June, 1948. The prizes will be awarded for original scientific contributions in chemistry, physics, engineering or chemical engineering of post-graduate standard, and having a bearing on the plastics industry. Two of the prizes will be open for competition only for employees, of not less than 12 months' service, of member firms of the Federation. One prize will be open to anyone domiciled in Great Britain.

Contributions should be sent to the General Manager, British Plastics Federation, 47-48, Piccadilly, London, W.1, so as to reach him not later than first post on Saturday, April 24, 1948.

Annual General Meeting

The 13th annual general meeting of the Federation was held on March 16, at 47-48, Piccadilly, London, W.1.

The Chairman, in the course of his speech, expressed his appreciation of the services rendered by the representatives, often senior executives, of member firms, who gave much time to the work of important committees of the Federation. He also stressed the importance of the work done by the Main Technical Committee of the Federation in co-ordinating the work of the various group and section technical committees, and in co-operating with other bodies, such as the British Standards Institution. He emphasized the great importance of a strong and active trade association, able to speak for the industry and to watch its interests, and drew attention to the opportunity and the need for closer co-operation between the different groups within the Federation.

The report and accounts were adopted, and the auditors, Booth, Anderson and Co., were reappointed.

The officers of the Federation for the year 1948-49 are as follows:—C. F. Merriam (chairman), P. A. Delafield (vice-chairman), R. P. Anderson (honorary treasurer), W. Chas. Waghorne (immediate past-chairman). Members of Council:—G. F. Bassett, J. E. Beard, B. R. Bettridge, E. A. Bevan, T. L. Birrell, H. Boehm, H. Bridge, C. S. Dingley, T. C. Eckenstein, S. T. Ellice Clark, K. F. Eggar, J. E. Ferguson, C. H. Glassey, H. W. Graesser-Thomas, A E. Hancock, J. Harvey, A. A. Heath, Dr. E. D. Kamm, C. C. Last, L. McArd, Major Stanley M. Mohr, H. V. Potter, N. B. Punfield, J. M. Rimington, G. G. Ritchie, A. E. Skan, C. R. Todd, A. A. Tomkins, F. H. Towler, L. H. Wadsworth, F. E. Wall, E. G. Wertheimer, C. G. Wilde, A. H. Wilson. Co-opted Member of Council:—G. Dring (chairman of Main Technical Committee).

Prices and Profits

The Federation, as a member of the F.B.I., co-operated with regard to the Report on Prices and Profits recently submitted to the Chancellor of the Exchequer.

Steel for Mould Making

The problems of steel supplies for mould making have been taken up with the Ministry of Supply. A new order, revising the distribution of iron and steel, was made in January ("Control of Iron and Steel (No. 62) Order 1948," Statutory Instrument No. 81, 1948). So far as mould and tool makers are concerned small purchases can be made without authorization subject to certification of the amount obtained, as set out on page 3 of this Order. For larger supplies application has to be made to the Ministry of Supply. Arrangements for the supply of steel for moulders who make their own moulds remain unchanged.

Price Standstill Orders

Certain of these Orders which were to have come into operation on March 15, but were postponed to April 26 as a result of representations by the F.B.I. and other organizations, have been considered by representatives of the various groups of the Federation who are affected, and a number of problems arising from them have been taken up with the Board of Trade.

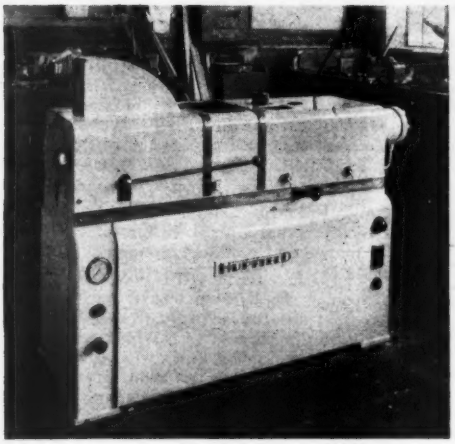
A special sub-committee has been formed to take up points of special importance to moulders and fabricators.

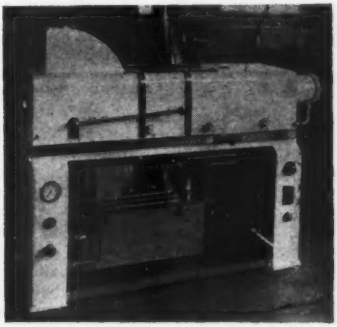
Federation Publications

Publication No. 24, "Report of the Synthetic Resin Section on Proposed Standard Methods for the Determination of Softening Point—Ring and Ball Method, and Melting Point—Capillary Tube Method, of Synthetic Resins," is now available, price 2s. 6d.

PRODUCTION NEWS

Raw Materials, New Plant, Works Organization, Control Apparatus, Research, Personal and Trade Notes





Hupfield semi-automatic 1-oz. injection-moulding machine: one view with front removed.

IMPROVED INJECTION-MOULDING MACHINE.—Various features to be highly commended are incorporated in a new 1-oz. injection-moulding machine which is being made by Hupfield Brothers, Ltd., of Dalston Gardens, Stanmore, Middlesex. This machine, the subject of two of our illustrations, occupies a floor space only 4 ft. 8 ins. × 1 ft. 10 ins. It is of welded steel construction, with a pleasing cream and chromium-plate finish, and to enable the operator to have a clear working space, the chute, by way of which the mouldings are removed, has been constructed at the back of the machine.

Fatigue of the operator is alleviated by the use of a counter-weight which works in conjunction with a patented toggle action, giving perfect freedom of movement when opening or closing the mould. This action linked with a safety cam makes the machine safe when the mould is in the open position; no guard over the mould is therefore necessary.

An adjustable stop is arranged to operate the ejector plate mounted in the moving platen, when the mould is in the open position. Mould changing is quite a simple matter, the machine having been designed without adjustments for simplicity.

The heating cylinder is of chrome-alloy steel, and is fitted with a stainless-steel torpedo to spread the material to the outer walls and provide for efficient heating. The cylinder is heated by means of two resistance bands clamped to the outside surface; a hand-controlled energy regulator regulates the heat of the band nearest the injection nozzle, the combined heat of both bands being finally controlled by a thermostat fixed to the cylinder.

The cylinder block is water cooled, this also helps to keep the injection plunger cool. Provision is made for cooling both halves of the mould; three valves on the front of the machine regulate the water supply to each respective part.

This semi-automatic hydraulically operated machine is said to be extremely simple to operate. After closing the mould, by aid of the mould lever, no power can be applied until this mould lever is completely depressed. The valve control lever, seen on the right, locks the mould and injects the plastic simultaneously. When injection is complete the valve control lever is reversed to withdraw the plunger from the material cylinder; the mould is opened by raising the mould lever; and by pushing the mould lever fully back, the moulding is ejected.

The maximum number of shots per hr. is 240; moulding area is approximately 10 sq. in.; plasticizing capacity per hr., 7 lb.

The total injection pressure is 5½ tons; mould closing pressure, 22 tons. The heating unit consumption is 700 watts. The Vickers rotary pump delivers 2½ gallons per min. at 1,000 lb./sq. in.

RADIO-FREQUENCY WELDING.—The "Redifon" process of welding by radio-frequency heating is described in a new brochure issued by Rediffusion, Ltd., Broomhill Road, Wandsworth, London, S.W.18. The process has been developed especially for the fabrication of plastics of the p.v.c. and related types. A useful feature of the latest equipment is the provision of interchangeable electrodes, thus covering a range of welding operations. The standard unit operates from any 40-46-cycle A.C. supply at between 190 and 250 volts, with an average power consumption of ½ kW. Fluted lampshades made from a weldable grade of cellulose acetate, tobacco pouches, compact holders and inflatable dinghies are illustrated in the brochure as examples of plastic goods produced by aid of the "Redifon" process.

NEW SYNTHETIC RUBBERS.—Phillip's Petroleum Co. of America is producing, on a pilot-plant scale, two new types of synthetic rubber known as Philprene A and B, both of which are butadiene-styrene co-polymers.

CANADIAN TRADE FAIR.—The first Canadian International Trade Fair will be held in Toronto, May 31 to June 12, 1948. The Plastics Section will include plastic-injection-moulding machines from England.

THE BOARD OF TRADE has amended the Miscellaneous Goods (Prohibition of Manufacture and Supply) (No. 7) Order, 1945, which provided for unrestricted supply by manufacture of mirrors, saucers and babies' pushers made partly or wholly of plastic material. Plastic cups, mugs and beakers may now also be supplied by manufacture without restriction, whatever their colour. The new Order came into force on April 1; it is referred to as Miscellaneous Goods (Prohibition of Manufacture and Supply) (No. 11) Order, 1948 (S.I. 1948 No. 585). Copies are obtainable from H.M. Stationery Office or through any bookseller, price 1d.

LAMINATED SKIRTING BOARD.—A range of skirtings for the building trade, produced in laminated plastic, has been introduced by Warerite, Ltd. This new form of "Warerite" is available in standard widths of 4 ins. and 6 ins. and in lengths up to 8 ft.; the thickness is 5/32 in. The advantages claimed are that of a tough, rot-proof and pest-proof skirting which is easily fixed and, moreover, available in a wide colour range to match or to contrast with any given colour scheme.

RETAIL BUYERS' CONFERENCES.—The first of a series of 10 conferences on design for retail buyers organized by the L.C.C. College for the Distributive Trades in association with the Council of Industrial Design, with the support of the Buyers' Benevolent Association, was held on March 1 at the L.C.C. College for the Distributive Trades, Charing Cross Road, London, W.C.2. These conferences are free and all engaged in retail trade are welcomed.

PUMPING EQUIPMENT.—Farrow and Sons, Ltd., of Spalding, Lincs, have just issued a comprehensive illustrated catalogue of pumps and pumping equipment.

EXPORT RESEARCH.—E. H. Jones (Machine Tools), Ltd., have established a research department in their export division, part of the functions of which will be to provide the management with information upon the economic position of countries dealt with, the rules and regulations which make up their continuously changing import procedure, and their potential requirements of machines, tools and measuring instruments. The new department is under the direction of Mr. C. F. Brook, who was previously with the British Export Trade Research Organization.

DUNBEE, LTD., announce the formation of a subsidiary, Beechfield Products, Ltd. The directors are D. M. Hannah, B. S. Feldman and R. Beecham. The offices will be at 10, Union Court, Wormwood Street, London, E.C.2. The new company has taken over a modern factory in London, and are manufacturing inflatable toys for which they now hold the European manufacturing rights of Walt Disney designs. Mr. J. C. Heath has been appointed production manager; he was formerly with A. C. Wickman, Ltd.

BRITISH GEON, LTD., is due to begin production of a comprehensive range of polyvinyl materials at their new 15-acre plant at Barry, Glamorganshire. This plant is the first of its kind in the British Empire. The Geon process of polymerization incorporates new developments in the control of molecular weight of vinyl resins, and produces materials of exceptional uniformity. The products include Geon 101 polyvinyl chloride, the Geon 200 series vinyl chloride vinylidene chloride copolymers, vinyl latices and paste resins.

P. B. COW AND CO., LTD.—The directors have recommended a final dividend on ordinary stock of 17½ per cent., less tax, making 30 per cent. for the year ending December 31, 1947. The company was incorporated in 1946, and made public in July, 1947. It acquired as at January 1, 1947, the undertaking and assets of (a) P. B. Cow (Streatham); (b) P. B. Cow (Queensbury); (c) Wembley Resinoids; and (d) London Moulders. Net profit of the group for the year, subject to taxation, is £249,312. Profits tax absorbs £39,900, income tax £73,318, reserve for subsidiaries' income tax, 1948-49, £11,200, leaving £124,894 for dividends and reserves. The interim requires £28,187: the final £39,463. After transfer of £35,177 to capital reserve there is £22,067 carried forward.

BRITISH INDUSTRIAL PLASTICS, LTD.—A resolution to increase the capital to £1,000,000 by the creation of 4,000,000 new ordinary 2s. shares has been approved. In his speech at the annual general meeting on March 17, the chairman, Mr. Kenneth M. Chance, said direct exports during the year under review exceeded £400,000 in value. In addition, buttons, which would otherwise have to be imported, were made from Beetle moulding powders to an estimated value of £350,000. Exports were spread over 23 countries, of which Australia, Canada, New Zealand, South Africa, Argentina and Brazil, and the hard-currency country of Sweden were the largest consumers. Within a short time the U.S.A. will be added to this list.

ROBERT McARD AND CO., manufacturers of plastic sanitary seats, etc., have announced a final dividend of 140 per cent., less tax, making, with the interim already paid, 190 per cent. for the year ended December 31 last. Profit for the year, before taxation, is £95,247; provision for taxation is £53,000, leaving a net figure of £42,247. Brought forward from previous year, £7,000, making a total of £49,247.

UNIVERSAL METAL PRODUCTS, LTD., of Pendleton, Salford, Lancs, who are makers of plastic mouldings, have opened a London office at Argyle House, 29-31, Euston Road, N.W.1 (Terminus 6326-7), with Mr. J. Elidge as their London manager.

RUBBER IMPROVEMENT, LTD., announce that they have acquired an auxiliary works in Wellingborough, Northants. The total floor space of 100,000 sq. ft. has been allocated for various lines of production in rubber and plastics. Apart from a substantial expansion in the production of plastic products and semi-processed raw materials, it is proposed to commence the production of conveyor belts. The head office of the company remains at "Leonex Works," Hythe Road, Willesden, N.W.10, but the sales office is shortly to be moved to 140, Park Lane.

A. BOAKE, ROBERTS AND CO., LTD., announce that their accounts department, which was evacuated to Buckhurst Hill, Essex, in 1940, is returning to the company's works at Carpenters Road, Stratford, London, E.15. After April 3, all communications about customer's accounts should be sent to Stratford. The shipping department is also returning to Stratford.

DR. W. H. GARRETT, director of production for Monsanto Chemicals, Ltd., has been appointed a member of the panel chosen to represent employers on the National Arbitration Tribunal. Dr. Garrett, who joined Monsanto's Ruabon works in 1917, is vice-chairman of the Association of Chemical and Allied Employers, and vice-chairman of the chemical Trade Joint Industrial Council.

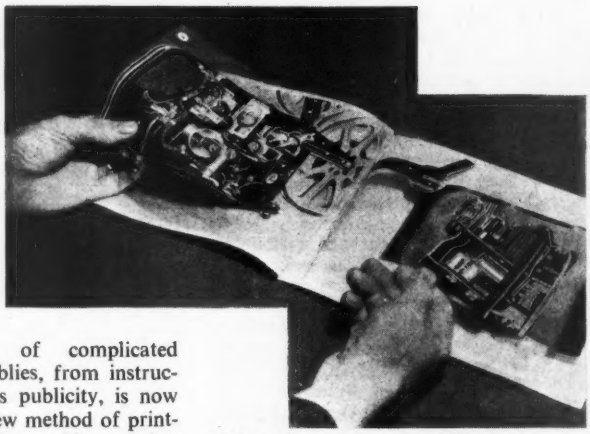
MR. M. FREUND, Dipl. Ing., M.I.Mech.E., has resigned the position of technical manager of the Plastics Division of E. K. Cole, Ltd., which he has occupied since 1941. Mr. Freund was closely concerned with the company's plastics expansion during World War II, and he also assisted its post-war programme in becoming established as trade moulders to the electrical, engineering, building and other industries.

MR. J. BELOHOUBEK, M.Inst.B.E., who during the six years of war was works manager and acting general manager of Aircraft Precision, Ltd., and subsequently was general manager of Dyne Engineering Co., has now joined the board of Kamm and Co., Ltd., cinematograph and scientific engineers.

MR. H. V. POTTER, B.Sc., F.R.I.C., M.I.Chem.E., managing director of Bakelite, Ltd., has been made a Freeman of the City of London. This follows on his earlier election to membership of the Worshipful Company of Horners. Mr. Potter has also been appointed Jubilee Memorial lecturer of the Society of Chemical Industry for the 1948-49 session.

MR. G. DAHL has been taken into partnership by his father, Mr. W. S. Dahl, who is well known as a supplier of wood flour.

Simplified Instruction for Intricate Mechanism



THE clarification of complicated engineering assemblies, from instruction aspect as well as publicity, is now made possible by a new method of printing on a transparent base. On opening the cover of such an instruction book or catalogue a large illustration of some machine, for instance, is seen. By lifting the first transparent page the cover plate of the machine detaches itself, to disclose the works immediately beneath, while the reverse side of the turned-over page shows a perfect view of the inside of the aforementioned cover plate. Moreover, as each subsequent page is turned, more and more of the intricacies of the machine are exposed to view. When the last page is finally turned, the machine is again closed in perfect register, and there seen from a totally different angle, thus giving the effect of dismantling and building up the job. With all the salient features numbered, these may be described in an index.

Applications of this method of printing upon thin sheets of transparent plastic are endless. The transparent sheets have a far greater tensile strength than paper, and stand up to handling very well. The accompanying illustration shows such a production, here reproduced by courtesy of Transart, Ltd., 107, Fleet Street, London, E.C.4, who have proprietary rights in the "Transart" process.

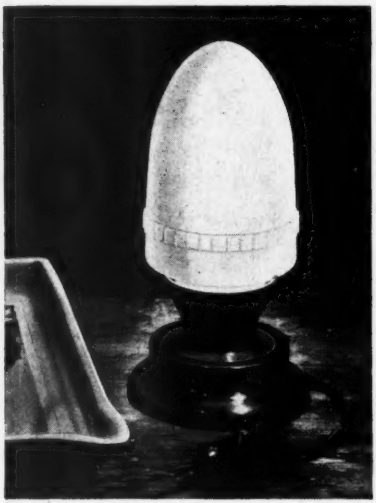
Acrylic Sheet in Improved Colliery Lighting

COAL faces in a number of collieries are now being experimentally lighted by small fluorescent tubes enclosed in covers of acrylic sheet, in consequence of a National Coal Board proposal to install permanent lighting of high intensity in all pits. The immediate aim is to improve lighting at faces and important road junctions, and ultimately to introduce the system from shaft to coal face.

Special units have had to be designed that satisfy the stringent requirements of British Standard Specifications as to optical design, impact strength, internal pressure and temperature. The fittings now on trial were made by G.E.C., Ltd., and B.T.H., Ltd., in collaboration with the Plastics Division of I.C.I., Ltd. They consist of small fluorescent tubes 18-24 ins. long, enclosed in relatively large transparent "Perspex" covers. A series of experiments had to be carried out to establish correct thermal design, as certain temperatures may not be exceeded; the covers were also subjected to arduous tests. Bends of ¾-in. "Perspex" exposed to the direct blast from shot-holes broke only when brought within 18 ins. of the hole, whereas the fittings are normally some 5 to 6 ft. away.

Work is proceeding on the development of improved units using both fluorescent and metal filament lamps. Meanwhile, reports show that the experimental units are proving successful. They will be operated for several months, and their performance checked; the results will form the basis for final recommendations by the National Coal Board.

New Productions from the Moulding Shops

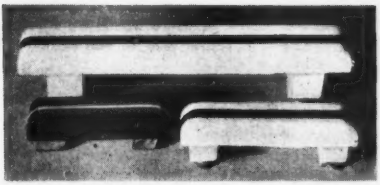


Portable Lamps

Two small portable electric lamps of all plastic construction, incorporating standard 15-watt "pigmy" bulbs, have been put into production by Cornercroft (Plastics), Ltd., Ace Works, Coventry. The "Printalite," which we illustrate, provides a convenient source of light for the professional or amateur darkroom, and has concealed ventilation. The "Kindalite," identical in shape, has been designed for the nursery, where it is particularly safe as all electrical contacts are out of reach of the most meddlesome fingers. As a nursery lamp, in a range of pastel colours, with coloured transparent gallery and opal shade, it provides adequate light at minimum power consumption to banish the fear of darkness in nervous children

Cabinet Handles

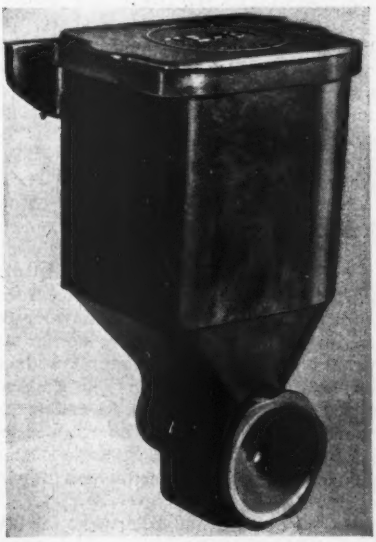
The "Plastikraft" colour-permutated handles produced by Fabricated Plastics (Oxford), Ltd., of Waverley Avenue, near Chesterton, Bicester, make due contribution in solving the problem of "individual" taste in furnishing. Manufactured from tough acrylic sheet they are strong and unbreakable under normal conditions. All colours are in pastel shades and guaranteed fast. The combination of two colours in one handle represents an advance in the technique of decorating handles. Eight basic



colours—green, blue, pink, jade, black, yellow, cream and opal—make possible a wide range of colour combinations. The fitting of these handles is simplified by the pointed fixing screws; all that is necessary is a slight pressure of the handle placed in the position it will occupy on door or drawer, following which the centres so marked may be drilled with assurance of accuracy.

Tea Dispenser

We found this "Teasy" tea dispenser in one of the London stores, but have no information regarding the makers. It is moulded in cellulose acetate in four parts—body, lid, valve and handle. The valve is in the form of a recessed plug, which may be turned within fixed limits to measure and deliver the normal quantity of tea for one household "brewing."



Quality Control in Plastic Moulding—V

This instalment continues the study of quality control procedure to be adopted in connection with production from a portable manual compression mould for sleeve. From the data already elicited in the preceding section, control and range charts can now be constructed and applied.

Methods of using these two related charts are here described, pointing out particularly the advantages to be derived. Such advantages comprise, improved inspection of components. reduction in number of defectives or scrapped parts, lessened inspection needs, and general all-round improvement in the complete moulding sequences.

By W. M. HALLIDAY

HAVING derived the essential data relating to the production operation of a portable hand-operated compression mould for the kind of moulded sleeve component illustrated in the March issue of "Plastics" (page 142), we may now proceed to the next stage in setting up control over production therefrom.

This stage consists of constructing the requisite control charts for use in conjunction with the normal routine production from the mould. These charts will be used and compiled as production proceeds by the inspector and will be filled in from data actually obtained from judicious inspection and measurement, etc., of pre-determined numbers of moulded components, as will be explained later.

Not only will these control charts indicate defective and faulty components as these occur from time to time during a production run, but, what is equally important, they will also provide recorded information respecting the behaviour of the mould, and operator, in so far as variations or changes in either produce undesirable deviations in the finished product. Thus tendencies towards such undesirable changes will be readily depicted on these charts for the better guidance of inspector, setter and mould operator alike.

As already explained, with quality control of hand operators of the kind now under construction, it is possible to secure a check upon the behaviour of the operator as well as the moulding tool. It will be appreciated that departures from the proper method of using the manual mould may entail serious variations in the dimensions, surface finish, quality and accuracy of the finished moulded part.

With ordinary and customary inspection methods generally employed in connection with such tools, the effects of such unconscious or inadvertent changes of the moulding procedure might not become apparent until a large quantity of faulty parts had been produced. This risk is present with all usual inspection methods because they are solely concerned with finished results, as shown in the checking of the completed mouldings and not with developing tendencies towards variations and errors, as is the case with quality control methods of inspection.

How this latter beneficial provision operates will be discussed later in this article, when we come to the examination of the recordings made on the control charts continuously as production has proceeded.

Preferable Use of Control and Range Chart

With the type of moulded article under consideration, i.e., having three different dimensions, as well as weight and surface finish to be carefully controlled within drawing specifications, it will be preferable to employ two separate charts.

The first chart would take care of the average values of control denoted by the symbol $\bar{X}$ (see "Plastics," March, 1948, p. 149). Plottings made on this chart would, therefore, represent the sample

averages and their positions on the graph would indicate a production trend. The direction and nature of such a trend constitutes the inspector's danger signal that variations are taking place due to some assignable cause, thus meriting careful investigation.

The second chart covers the variations in the batch ranges $\bar{R}$, described in detail on page 150. This chart is extremely important, because it indicates the extent of such trends of variation shown on the first control chart.

A further reason for the use of two distinct charts of the above kind, instead of a composite one, is that their compilation and interpretation is very considerably simplified. This will be found a great help for those making a first acquaintance with the use and application of quality control procedures. As such experience increases, the charts for average values and range may be usefully combined to obtain certain economies, as will be more fully explained later.

Average-value Control Chart

Commencing with this chart, it is well to point out that it will be advisable, and in many ways highly convenient, to construct it to an ample scale on a large sheet of stiff paper. The chief reasons only can be mentioned at this juncture.

If the chart is laid out to a very small scale, the plotted points to be filled in coincident with production will be located too close together. Such an unwise crowding together of these important plottings would render it exceedingly difficult for the inspector or other observers concerned with the charts. Furthermore, with such a small scale chart, the degree of wander, or staggering of the plotted points will be difficult to observe with accuracy since such wander will be spread over a minute area of the chart. Thus an important deviation occurring in the production might be completely overlooked due to no other reason than the plottings showing such a departure are so closely located together on the chart as to render it difficult to interpret their signal.

It has also to be borne in mind that one of the many valuable functions performed by these methods of quality control inspection is to enable interested passing observers, such as the mould setter, inspector, works foreman, or production engineer to observe at a glance the tendency of production whilst some distance away from the moulding press. It follows, therefore, that the charts should be plainly discernible by a person several yards away, a provision completely negatived if they are constructed on too small a scale.

For these and other reasons which could be given if space permitted, the writer would strongly urge the selection of the largest scale possible for all these charts.

Establishing the Positions of Control Datums

From the data already secured, the exact position of the control datum lines on the average-value graph can now be computed. This has to be done with a certain degree of exactitude because the relative positions of these important datums is essential for the correct control of the moulding operation. These datums must be determined in strict relationship to the natural limits applicable to the job as well as to the drawing specifications and tolerances. A small error in the location of these datums may have the effect of providing wrongly positioned datum lines on the chart, thereby allowing a scale of variation on the moulded articles which would prove harmful and erroneous.

These locations of the control datum lines are calculated from the data previously obtained and put in tabular form (see Fig. 2, March issue of "Plastics," p. 149). The basis of the calculations is the size of the sample group selected for the job, the grand average value $\bar{\bar{X}}$, and a calculated constant value derived from statistical investigations into quality control problems and which have been amply proved in actual production practice.

It would take us too far away from the

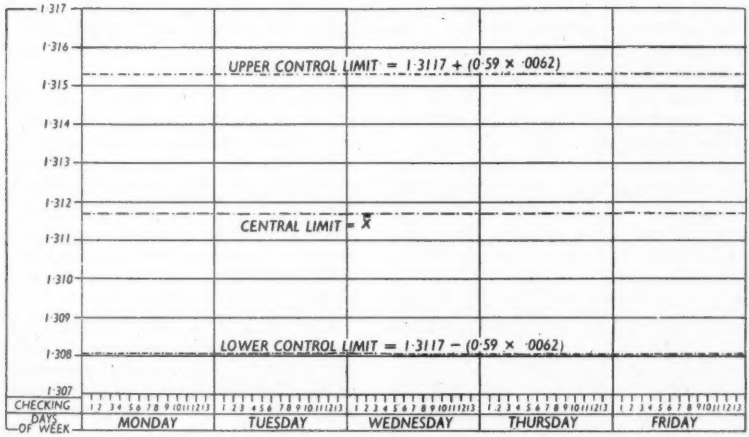


Fig. 1.—Average-value chart.

prime object of this article to follow through the arithmetical derivation of this latter constant and, fortunately, this is not necessary, because such values have already been fully computed and published in tabular form for the convenience of production engineers. Such a useful table is to be found on pages 35-36 of that helpful guide, "A First Guide to Quality Control for Engineers," which has already been mentioned in these pages.

First, the constant value applicable to a sample group of five components has to be found, as this, it will be recalled, was the size of the sample group selected for this moulded component.

Referring to Table 1 in the above booklet, a constant value A equal to 0.59 is given for the sample group size of 5, such as we are now dealing with.

With this constant we can now easily compute the relative dispositions of the control mean datums, which are derived from the formula: $\bar{\bar{X}}$ plus $A \times \bar{R}$.

Where $\bar{\bar{X}}$ is the grand average of the 10 group variations, A is the constant already described, and $\bar{R}$ is the range of variation over the sample components. The above formula will give the position of the upper control datum and the following formula gives that of the lower control datum: $\bar{\bar{X}}$ minus $A \times \bar{R}$.

Calculating the datums upper and lower, for dimension A, viz., the outside diameter of 1.312 of the moulded component, we get:—

Dimension A.
1.3117 plus (0.59 × .0062) = 1.3153 upper limit
1.3117 minus (0.59 × .0062) = 1.308 lower limit
Central datum = $\bar{\bar{X}}$ = 1.3117

Employing the same basis and method of calculation for dimensions B and C respectively, of the moulding, we obtain the following positions for the datum limits.

Dimension B. Upper limit = .752
Central limit = .749
Lower limit = .746

Dimension C. Upper limit = 1.0643
Central limit = 1.0606
Lower limit = 1.057

These calculations will illustrate the basis of the calculations and the simple way in which the positions of the datums are ascertained from the already established data (see Fig. 2, "Plastics," March, 1948, p. 149).

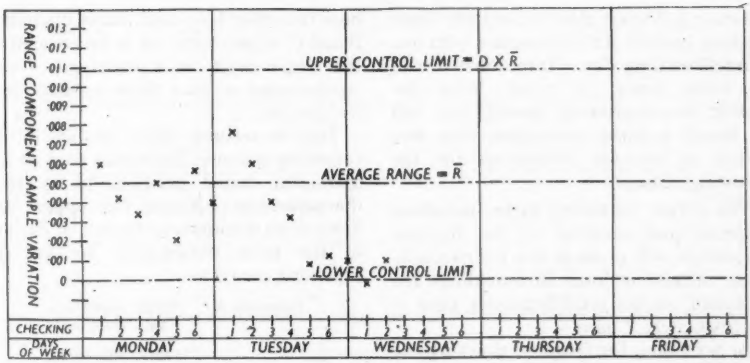


Fig. 2.—Range chart.

Determining the Datum Positions on Range Chart

Turning next to the location of the control datum lines to be established on the range chart, similar calculations are necessary, which again employ the use of a statistically ascertained and verified constant.

This constant value, known as D, will be found in column 3 of Table 1 on page 35 of the handbook already mentioned. Here, again, the constant bears a strict relationship to the size of the sample group chosen for the job.

In our particular case this latter, being 5, we obtain a value of 2.08 as constant D. With this we can now reckon out the positions of the datum lines on the range chart from the following formula:—

$D \times \bar{R}$ equals the upper limit.

DIMENSION A. Upper limit .013. Central limit $\bar{R} = .006$, and the lower limit = zero.

DIMENSION B. Upper limit .011. Central limit $\bar{R} = .005$, and the lower limit = zero.

DIMENSION C. Upper limit .013. Central limit $\bar{R} = .006$, and the lower limit = zero.

Average Value Control Chart

At Fig. 1 is shown the average value chart of sample means with the control datum lines as just ascertained. Fig. 2 shows the range chart similarly constructed.

As will be observed, the chart at Fig. 1 is provided with the usual horizontal and vertical ordinates. The latter at the left-hand side is suitably graduated as shown. These graduations must range over a distance greater than the limits given by the calculated datum positions.

To ensure this, the lowest value X must be taken from the upper portion of the table, Fig. 2. This will be found in the vertical column 4, and is 1.307. Next, highest value should be found, which will be found in column 8 as 1.3165.

The graduations on the vertical ordinate of our graph, therefore, range from 1.307 to 1.317; that is, 10 equal spacings must be provided. Each of these spacings is sub-divided into 10 equal spaces, each of which may either be ruled off horizontally across the graph or indicated by short reference lines as desired.

On the horizontal ordinate an equally spaced series of graduations are provided, each being ruled off vertically to the top edge of the chart as shown. These graduations are determined by the number of inspection tests made in each period of time, as predetermined. In the case of this moulded article, it will be remembered that samples were originally taken every 25 mins. This period, it is true, was chosen purely for the purpose of obtaining a satisfactory sampling of the mould output, but it may be retained or modified slightly as desired for the use of the control chart being considered.

In this present example the horizontal

ordinate is divided into five equally sized sections, each of which coincides with one normal working day. Inspections are to be made every 30 mins. With the present five-impression mould, this will be found a most convenient and safe period in between inspections for the following reason:

The actual moulding cycle, including stripping and removal of the finished mouldings, will produce five components. Thus, in half an hour 20 mouldings are produced, as the moulding-cycle time is approximately 7 mins.

By providing for frequent checkings of the time just stated, it will speedily be found possible for the inspector to test and gauge only a single component of each batch of 20 parts, produced since the previous check.

If the period of inspection were to be made, say, once every 2 hrs., then practically 90 mouldings would be awaiting inspection, and from such a large number it would be advisable to gauge and *check at least five components* to give reliability. Thus, it is possible to balance out the time required to check a relatively large number of mouldings, selected from a much larger batch, against the small amount of time required to check a single part at more frequent intervals.

Each of the main five horizontal sections of the chart is then sub-divided into 14 equal spacings, to coincide with a 7-hr. working day.

The upper control limit for dimension A, viz., 1.315, is then ruled off at the appropriate division on the vertical ordinate as shown; similarly with the central and bottom limits. It is customary to rule these in different colours, so that they are prominently visible. Heavy broken lines are employed in the present illustration, however.

The chart is thus completed, with the exception of one important point. It will be appreciated that as so far constructed the chart only covers one dimension of the component, i.e., its outside diameter A. It will doubtless be asked with point how the other bore and recess diameters, B and C respectively, are to be covered on this single chart, as it would prove very cumbersome to have three separate control graphs.

This is secured quite readily in the following manner: Referring back to the calculated datum positions to ascertain the differences between the upper- and lower-limit positions in respect of each of of the three dimensions, we get the following details:—

Dimension A.	1.3153	upper limit.
	1.308	lower limit.
	0.0073	*difference*
Dimension B.	.752	upper limit.
	.746	lower limit.
	.006	*difference.*
Dimension C.	1.0643	upper limit.
	1.057	lower limit.
	0.0073	*difference.*

Thus, from these figures it will be seen that the control limits for the ¾ in. diameter of bore of the component are situated nearer together than either of the other dimensions. Therefore, if the control chart were to be graduated to suit this single dimension, as illustrated by the third chart depicted at Fig. 3, the limits of control imposed on the remaining two dimensions on the component would, in fact, be slightly stricter or finer than that given by the calculations just completed.

In actual practice this would be all to the good and enables a chart to be used having only this set of control limits as shown. The vertical ordinary, however, is provided with three scales, each one coinciding with the range of sizes for dimensions A, B and C respectively.

Determination of Drawing Limit Datums

Except for the provision of the datums for the drawing tolerances applicable to this moulding job, the chart is complete for use.

Again the location of these drawing tolerance limits on the control chart must be calculated, and the following rule is employed for the purpose. The average

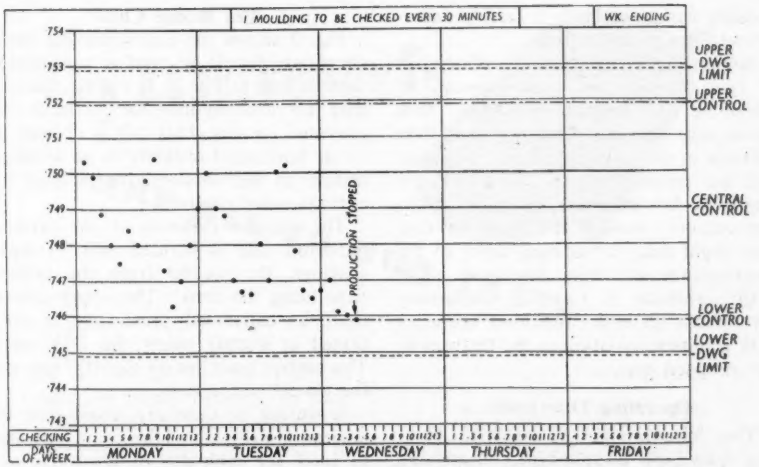


Fig. 3.—Complete Average-Value Chart: in actual use different coloured plottings would be made, e.g., for "dimensions" (black), "weight" (red), "surface finish" (green).

sample range over a given period must never be greater than L times the stipulated drawing tolerances, where L is a constant based upon the size of the sample group.

Table 2, to be found on page 35 of "A First Guide to Quality Control for Engineers," gives the values of this constant in respect of various sizes of sample sets. From this table we find that in our present case of five individual components per sample, group L equals 0.37. Therefore, by multiplying the value $\overline{R}$ obtained from the sample groups and given in "Plastics," March, 1948 (Fig. 2), we obtain the following results:—

Dimension A.	.0062 × .37 = .0023
Dimension B.	.0054 × .37 = .002
Dimension C.	.0063 × .37 = .0025

These indicate the minimum positions for the location of the drawing tolerances of the chart in relationship to the control mean lines already established.

It will be noticed that the smallest value is that for dimension C, which, again, is the only one selected, datums being marked off on the chart as shown at Fig. 3 for this dimension alone. If all the three dimensions on a component being gauged are found to be within this limit they must be correct.

Sometimes on certain moulding operations it will become necessary to reduce these calculated values for the position of the drawing tolerances by 5-7½ per cent. in order to cover for variations and fluctuations arising during the setting of the mould. This will generally apply to split-type compression moulds, where the operator has a number of loose splits to assemble and which must be put together in a clean and correct and expeditious manner if satisfactory moulding is to ensue. With such kind of moulds it often happens that small particles of uncured powder are not properly cleaned from the splits, or their seatings in the bolster, which will cause additional flashing and, perhaps, increased difficulty in extracting the finished moulded components. This, in its turn, may result in the formation of additional undesirable distortion, leading, in due course, to departure from proper shape or correctly toleranced dimensions on the completed moulding. Thus, some provision has to be made on the control-limit datums on the average-value chart to cover such

possible variations likely to lead to under- or over-size moulded parts.

Similarly, the task of dismantling such a split mould, for the purpose of removing the finished moulding, with subsequent cleaning of the splits and their seatings in the respective forces or chase, and the reassembling of these parts in readiness for the next moulding cycle, may occupy a considerable length of time. Any slight delay or slowing down of the performance of these functions might easily produce a lack of uniformity throughout the entire moulding sequence with resultant variation in the features of the moulded part.

Operating Drawbacks

This, indeed, is one of the chief operating drawbacks of split-type compression moulds, because it is often found that the length of time absorbed in breaking down the tool, withdrawing the splits, removing the mouldings, cleaning and then building up the mould members leads to wide variations in mould temperature. Obviously, the longer the mould is off the press for these operations, the greater is the loss of its heat. All this would be reflected in adverse shape and size variations on the moulded part. These could easily develop in excess of those permitted by the drawing tolerances limiting the component size unless due provision is made on the control charts.

These, fortunately, are relatively isolated instances, since split-type moulds are not employed, unless absolutely unavoidable, for the above and kindred reasons. Generally with positive and semi-positive compression tools the determination of the drawing-tolerance limits for the datums on the control chart, as already explained, will be found to produce very reliable and satisfactory means for controlling the production.

The average-value chart shown at Fig. 3 is also provided with the datums representing the drawing tolerances for the job positioned in relationship to the other control datums, thus completing this chart in readiness for use.

The Range Chart

Fig. 2 shows the accompanying range chart, which will be used in conjunction with the one at Fig. 3. It will be observed that no drawing-tolerance datums are provided on this chart. It is divided up on its horizontal ordinate in an identical manner to that obtaining on the chart for average-value control.

The vertical ordinate at the extreme left-hand side is divided into 16 equal spacings, the second from the bottom edge being the zero. The upper control limit, as calculated previously, is positioned at slightly below the .011 mark. The central limit lies on the .005 line and the lower limit is zero.

It should be carefully noted that the horizontal ordinate of this chart is divided to cater for each day of the week, and each of these daily compartments is divided into seven equal spacings, instead of the 14 on the average-value chart at Fig. 3. The reason for this is that, on this moulding operation—the tolerances being fairly substantial—it was found that checkings of samples for compiling this range chart need be made only once every hour.

Using these charts, one moulded part would be checked every *half-hour*, and the results of the gauging, etc., plotted on the chart shown at Fig. 3, and sample mouldings would be checked every hour and the plottings made on the range chart in the manner depicted. The number of samples to be checked at the latter period would, of course, be five, the same number, in fact, that were selected during the preparatory stages when getting out the data for these charts.

These five sample mouldings would be carefully checked on their dimensions and the average variation ascertained in the manner already described in the preceding section. This average value would then be plotted each hour on the range chart.

Incidentally, it is preferable to employ a different type of plotting mark, so as to distinguish more readily from the chart at Fig. 3. Some moulders and engineers use

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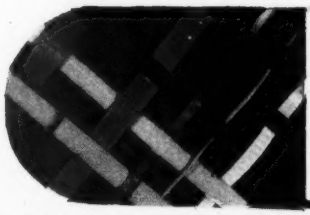

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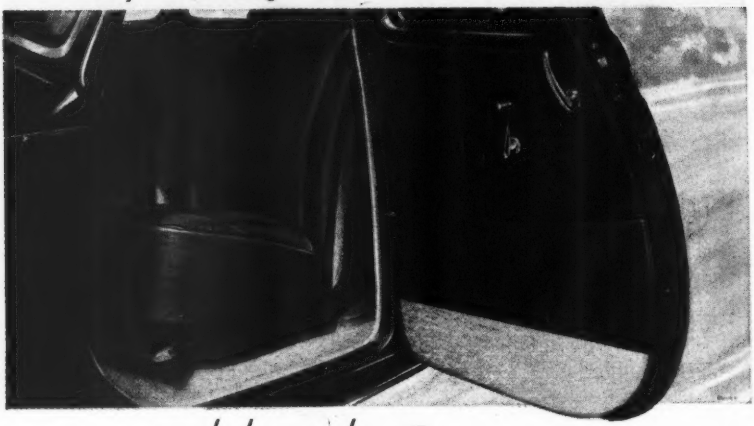

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a different colour for the range chart for this purpose.

As will be noticed, a production run of slightly more than two days has been plotted on both these charts, in order to illustrate their operation and also to indicate several important points worthy of careful attention and which are explained. A number of advantageous features will also be remarked in respect of the use of these charts in connection with the production of this moulded sleeve.

Interpreting the Charts

Referring first to the chart of average values illustrated at Fig. 3, it will be noted that a number of points have been plotted covering Monday and Tuesday and the early part of Wednesday. It is obvious that production from this mould remained fairly stable and within control on the first two days, as exhibited by the location of the plottings, which, it will be seen, lie well within the control datums and considerably well away from the datums of the drawing tolerances.

That the produced mouldings were also remaining steady in respect of variations in their dimensions is further evidenced by the plottings on the range chart at Fig. 2. Here, again, on the first two days no plotted point approaches too close to either datum, at least not until late on Tuesday.

The last three plottings made on the range chart on the second day, however, shows that something untoward is occurring because three points are located very close to the lower datum. Similarly, with the average-value chart, during the latter part of Tuesday there is a marked tendency for the plottings to crowd close to the lower control-limit.

At two consecutive half-hourly checkings on the Wednesday morning the plotted points had a still more marked trend towards the lower control limit on the chart at Fig. 3, and, in fact, at the fourth inspection the point occurs dead on the control-limit line. This clearly demonstrated to the inspector that something was out of control.

Accordingly, production was stopped at this stage in order to examine the mould and to check up thoroughly upon the whole moulding production procedure. Whilst this was being undertaken by the mould setter, the total quantity of mouldings produced since the previous visit and checking by the inspector were segregated and given a 100 per cent. gauging and weighing test on every feature to be held to a tolerance.

Sure enough, a percentage of the mouldings from this batch were found to be under size on the recess diameter and the bore diameter, the percentage being approximately 9 per cent. of the total batch.

Earlier in this series the author described the methods of arranging the inspection of such production components. This should preferably comprise of some way whereby each batch of moulded parts produced in between the periodical inspections is isolated, so that in the event of an occurrence of the kind we are now considering it will be easy for the inspector to segregate such a batch to give the parts a 100 per cent. inspection.

Examination of the mould revealed that the top force carrying the punches for forming the bore and recess in the mouldings was not seating down properly, due to a shifting of the pressure pads. The fastening screws for these latter members had become released slightly, allowing excess semi-cured material to enter into the interstice thus formed, so gradually building-up until the top force was held out of correct position sufficient to effect a variation in the size of the parts.

One of two important considerations arise at this juncture which are worthy of attention. In the first place, the actual scrapped mouldings produced as a result of this undesirable, yet understandable, mould variation was 9 per cent. of a single patch produced in half an hour's run. This means that two mouldings were found definitely outside the limits and one on the borderline.

With customary inspection methods, consisting of taking a batch of mouldings at, say, the end of a couple of hours' production run and gauging same, would certainly have involved a much larger volume of faulty mouldings before the variation had been demonstrated to the inspector.

Again, it is interesting to contrast the warning afforded to the inspector by the two methods. With that covered by the control charts from the later part of Tuesday afternoon, the inspector would be on the alert, since all the indications of the plottings on the charts showed a *trend* towards an early passing beyond the control limits. This, in fact, occurred on the Wednesday morning, as we have seen.

With ordinary inspection methods, however, no such warning would be given, the first intimation that all was not well with the production being afforded by the discovery of a considerable proportion of defectives from the batch of components being inspected.

This example amply illustrates how important the *trend* of plotted points on the control chart becomes to the inspector. When such a trend takes a direction too close to either control line it becomes a distinct danger-signal and bespeaks critical examination of the mould or moulding sequence before further production is run off. The range chart clearly depicts the extent of such a trend.

Chance variations will normally take place with the control of any plastic-moulding production, but this will only give isolated scattered plotted points which will usually range well over the area bounded by the control lines, and may even occasionally pass beyond these confines.

In contrast to this, where the plotted points show a definite trend towards one of the control lines it always indicates trouble of some kind or another. This, in turn, means that an assignable cause can be found upon investigation.

It is often extremely helpful to an inspector, in cases where such a trend is observed on the charts, to increase the frequency of the sample checkings required for the range chart. Thus, in our present example these checkings would probably be made once every half-hour, commencing with Wednesday's production.

This would have to be effected if the tolerances upon the component being moulded were very close, because, since the datums on the control chart are based on *average* values, the closer the limit and the greater danger there would be of defectives being passed through. Closer limits on the job would mean that the control lines of the chart would have to be located nearer together and in closer proximity to the datums representing the drawing tolerances.

An alternative step would be to increase the number of individual mouldings in the sample group for the range-chart plottings. Thus, instead of taking five mouldings, 10, or even 15, could usefully be checked. By increasing the number of items in the sample set the resulting average value for plotting purposes would be more accurate and thus give even a more correct picture of the extent of the trend noted on the average-value control chart.

After such a mould-production stoppage it is advisable to take a set of samples, measuring these very carefully, and then ascertain the average amount of variation, i.e., value $\overline{R}$. This is necessary because very often after a mould has been corrected some slight deviation from original accuracy or smoothness of operation will be noticed. Such a feature may make it necessary to provide fresh datum control limits on the range chart in order to keep this graph in correct relationship with the altered conditions of production.

Unless such a check-up is made after each mould repair it may be found that the charts do not give a true picture of the production activity, either because the limits are too close or too wide.

It will also be appreciated that similar re-checking will be required after any

modifications of the moulds which is likely to cause a change in the volume, size or other features of the finished moulding. If a change-over is made to a slightly different moulding powder, it will again be advisable to re-check at the commencement of production to ensure that the control charts are retained in proper relationship to the job in hand.

Very often it happens that the two forces of a mould may be registering together in an incorrect fashion, and if this is not rectified faulty mouldings, which are oversize in respect of some dimensions, may result.

If such an occurrence took place on the mould just considered as an example, and where the components produced therefrom are controlled by means of charts of the kind illustrated, it is evident that the condition would at once be revealed on the chart by an alteration in the general level of the plotted points on the average-value chart. A similar state of affairs would arise if wear on the mould forces or other mechanism resulted in oversize moulded articles.

This important point must be constantly borne in mind when fixing control limits on the quality control charts, and especially immediately after a mould overhaul or repair when production is restarted.

At certain stages during the compilation of the control chart it may become necessary for the inspector to distinguish the plotted points in order that he can tell which ones refer to the dimension checkings and which refer to weight or surface-finish variations observed on the sample mouldings. For example, an occasion might arise when the weight of some mouldings exhibit abnormal variations, whilst the dimensions and surface finish are generally reasonably stable within the predetermined limits.

This feature may develop as a result of mould wear or the failure to close the mould forces properly, to mention only two ways in which weight alterations could occur. If such a circumstance is encountered, this information must be recorded on the control chart in such a way as will indicate unmistakably the true nature of the deviation.

To accomplish this quite simply, it will be advisable to employ plottings of different colours. Thus, should the weight tend to decrease down to the bottom limit imposed, additional plotted points should be supplied on the chart in a conspicuously different colour from those used to indicate the normal dimensional conditions. A useful colour range would be as follows:—

For normal compiling of the chart to control the dimensional variations, which, of course, are the most important factors to control, black plottings should be made. Red plottings, either in solid dots or crosses, should refer to weight variations of the kind just discussed, and green should be used for plottings referring to surface variations.

Of course, it will be appreciated that the dimensions on the moulded part will be the feature most likely to vary, because if the mould charge of powder is accurately weighed and a proper measuring instrument supplied to the mould operator, with operation at correct temperature, pressure and timing, both weight and surface finish should be maintained stable.

In addition, if the cavity walls are kept free from damage or excessive staining, with the mould well cleaned in between lifts, this will further promote steady maintenance of surface finish to the quality desired.

In the light of the above remarks, the inspector would carefully weigh each sample component taken at his regular visits to check production. If this was within the specified limits he would not plot a red point on the chart. Likewise with surface finish, if this was to standard no green plotting would be made. He would next test for dimensional accuracy, and if all these were to correct limits a black plotted point only would be made on the average-value control chart at the appropriate position in the control area.

(*Continued on page 220*)

The Microscopic Examination of Plastic Materials

VII.—Mouldings (Contd.)

By J. H. WREDDEN, F.R.M.S.
(Chief Chemist, Igranic Electric Co., Ltd.)

THE previous article in this series dealt with general aspects of thin sections of mouldings as seen under the microscope. It is now proposed to deal with the examination of specific materials of known composition, with the object of ascertaining as much information as possible, in the light of which the identification of materials used in mouldings may become more certain.

Commencing with the examination of mouldings made from a powder containing ground flax shive as a filler, the visual aspects produced by the filler in situ must be emphasized, as the particles are as a rule the most easily recognized component in the structure of a thin section as seen by transmitted light. As the filler also occupies the greater portion of the volume of the moulding (at least where organic materials are used for this purpose) it is important that it should be capable of being seen and identified, because this component is the one which may be generally considered to have pronounced effect on the properties of the finished moulding. Therefore it is necessary to examine initially the materials whose constituents are known.

The material now to be examined was made up with a standard resin (30 per cent.) and ground flax shive (70 per cent.) as the filler. No dye or pigment was incorporated as it was desired to produce a material with the maximum transparency so that at this stage the difficulties involved in examining mouldings containing these materials may be eliminated. These materials have a strong tendency to make the sections very opaque, and, as may be imagined, these latter have to be made excessively thin in order to attain the necessary degree of transparency; indeed, it is quite possible that conditions are such as to necessitate a section which is so thin as to be almost valueless from the diagnostic point of view. It should therefore be remembered that the possibility of making a section too thin is a very live one, and in cases of very dense materials there exist other methods of obtaining the necessary information by indirect means. These methods will be discussed in greater detail subsequently.

In examining a prepared section of a moulding, we shall employ the principles mentioned in the early portion of this work, i.e., first examine the preparation under low magnification in order to obtain a general idea of the structure. In Fig. 275 we see a section of a moulding filled with ground flax shive at a magnification of 40 diameters; at first sight one is extremely puzzled by the nature of this structure because it appears so totally different from the actual material of the filler, in the raw, as it were. A little thought on this point will, however, throw much light on the problem. In the first place we must know what a flax shive particle looks like, both in transverse and longitudinal sections. This material has been dealt with in this manner in the section embracing fillers, and if we require to refresh our memories regarding the appearance of shive, in longitudinal and transverse sections, these appear in Figs. 99 and 100 ("Plastics," July, 1946, p. 363).

Knowing what the material looks like before being used as a filler, it now becomes necessary to try to imagine the alterations we would expect to be brought

about when it has been incorporated as a filler, moulded and then sectioned. Of those modifications, the most outstanding is that brought about by particles not being sectioned in the true directions; thus we may expect to find numerous cases of particles which were so orientated in the material that when this latter was sectioned the particles in question were sectioned at various angles to the true transverse and longitudinal axes.

This condition may easily be seen, even at quite low magnifications, in the case of the larger particles of the filler. Two such examples are illustrated at A in Fig. 275. Thus it will be seen that the images produced by this condition can be interpreted only in terms of a foreknowledge of the material. At the same time, it should be borne in mind that just as there are numerous cases of the aforementioned modification, so there is every likelihood of the existence of particles which have been correctly orientated and in consequence sectioned along one of the two axes, thus producing a true image which may be used as a comparison.

A knowledge of this is very necessary as it is too easy to ascribe a certain identity to a particular particle which is so orientated as to appear thus, when in reality it is something entirely different, for it will be appreciated that the variations from the true axes may be so wide as to produce large divergences from the true gross morphology of the particle. Subsequently, this will be shown to be so.

Apart from the apparent alteration of general particle shape in this manner, we must also bear in mind the greater probability of a considerable real alteration in shape brought about by the moulding processes and temperatures. In this case it is obvious that some fillers will be more greatly affected in this direction than others, but in the case under consideration does not to a very great extent, owing to the nature of the material. We know that the particle is naturally somewhat "flat" in transverse section, and although this flatness varies between

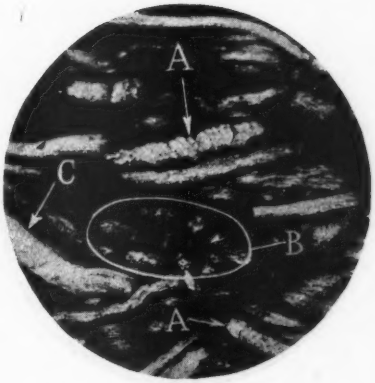

Fig. 275.—Section of flax shive-filled moulding. Mag. 40 diameters.

fairly wide limits, nevertheless the shape in this direction may be regarded as characteristic of most shive materials. The particles marked A, exhibit this tendency strongly, in spite of the fact that they are not true transverse sections. In contrast to this, the groups of small particles shown at B are more oval than flat, but these are much smaller than the A particles and, no doubt, are portions of similar large units. However, in the case of flax shive, there appears to be little alteration in shape and in general the particles seen in cross section still show the characteristic shape.

Taken generally, this section (at the magnification indicated) shows a good picture of the way in which the particles arrange themselves. The section itself is taken from the centre of a fractured test piece for tensile strength. The piece was of the standard dimensions demanded by the B.S.S. 771. It may therefore be regarded as a transverse section of the moulding, and in the illustration the two largest sides of the section would be at the top and bottom. From this it will be seen that there is a decided tendency for the particles to orientate themselves in layers, although the smaller ones, as at B, appear to be bunched; it should be remembered that they might be long particles with their long axis lying almost

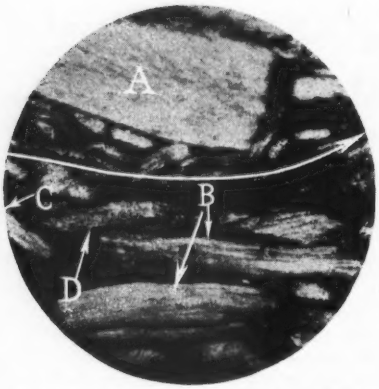

Fig. 276.—Section of flax shive-filled moulding. Mag. 40 diameters.

parallel to, but at right angles with the other particles, such as C, seen in longitudinal section. Thus, there exists a distinct possibility of formulating the conclusion that this happens as a general rule where filler particles are concerned. However, one example such as this does not provide sufficient evidence, and before any more definite assumption can be made it will be necessary to examine other materials.

Bearing in mind the large variability ratio of the ground flax shive, it is expedient to continue the examination of this section at the low magnification previously mentioned. In Fig. 276 we see another portion of the section under these conditions. Whereas the previous illustration (Fig. 275) shows a portion containing, in general, small and medium-sized particles, this portion (Fig. 276) is seen to contain a mixture of particles varying from small to large; the largest of these latter being marked A, which is a large piece of shive seen in a somewhat oblique cross section. The other particles, such as those marked B, are seen in longitudinal section A.

Regarding the general arrangement of the particles, it will be noticed that there still exists the tendency to horizontal orientation, but the presence of the large particle creates some disturbance to this layering effect, inasmuch as the small particles surrounding it are prevented from taking up a horizontal position, due presumably to flow effects taking place during this period of the moulding cycle. Thus we may reason that between the A and B particles, a channel would come into existence due to their comparative immobility occurring earlier than the mass of resin carrying smaller particles. This would be expected to flow through the channel, exhibiting a certain degree of turbulence, the effect of which is seen in the orientation of the particles in this region. It is only to be expected that larger particles carried along this stream would become wedged in the manner of that shown at C, thus further increasing the turbulence in the channel. However, it is difficult to say whether the particle at C was stopped by that marked D, or whether the whole group (B, C, D) was immobilized at the same time. If the former were the case, then the orientation of the C and D particles is to be expected. If, on the other hand, simultaneous immobilization occurred, then we should expect to find the C particle in a more horizontal position.

At present, therefore, it can only be assumed that the C particle was stopped in its progress by the D unit. The channel itself is quite clearly defined and its direction past the end of the A particle, curving upward as shown, affords some not inconsiderable interest in view of the fact that this change of direction was due to the presence of another very large filler particle which is shown in Fig. 277. Unfortunately this particle was too large to illustrate in its entirety; however, the channel curves over the top of the particle at the left-hand side of the photograph and the long horizontally placed particles, forming the lower boundry of the channel, may be seen at the top of the illustration. It is interesting to note that a similar arrangement occurs at the bottom of this large particle, where three of the medium-sized particles are seen to be more or less horizontally orientated against the lower face. This condition is very similar to the formation leading to

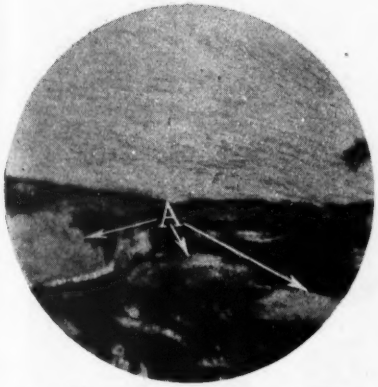

Fig. 277.—Section of flax shive-filled moulding. Mag. 40 diameters.

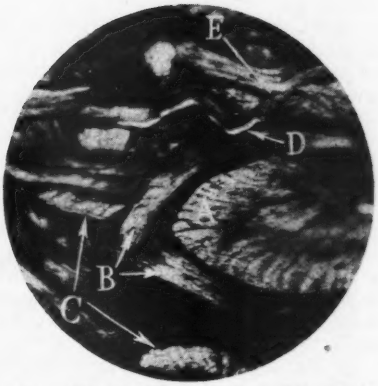

Fig. 278.—Section of flax shive-filled moulding. Mag. 100 diameters.

the development of the channel, and it would therefore appear to be a general effect resulting from the presence of the extra large particles.

This general impeding effect of large particles in the presence of a number of smaller ones does not appear to be limited to those of extra large size, for the same type of result can be seen to exist in the case of much smaller particles surrounded by smaller ones. It will be appreciated that this particular filler possesses a high variability index, signifying that the flour contains a number of different fractions. The difference in size of the average particle of the fraction containing the largest, and that of the fraction containing the smallest, is considerable. Thus the disturbing effect will be likely to occur between particles of the smallest size and those of every other fraction whose particles are larger. In the same way we might expect a similar effect between fractions all the way up the scale to the largest.

This effect is well shown in Fig. 278 which at first sight appears to be depicting a particle of similar size to those already discussed, but it must be borne in mind that in the case of this illustration the magnification is at 100 diameters and not 40 as in the preceding examples. The large particle A is, in reality, somewhat less than half the size of the previous examples. In spite of this, however, it will be seen that the presence of this particle has had a not inconsiderable disturbing effect on the orientation and layering of the smaller particles. The two particles marked B can be clearly seen to have been blocked by particle A, to the extent that they have orientated themselves in an almost vertical direction, and beyond these units the effect appears to be greater in the case of larger particles. The existence of typical shive cross sections will be noticed in particles such as those shown at C.

This, of course, leads to the question as to the validity of the assumption that these are small particles and not long ones seen in cross section. It is probable that this latter condition exists in these cases, and therefore it would appear to be more appropriate to regard all particles seen in transverse section as being some three or four times longer than they are broad, as this appears to be the average L.B. ratio for the filler. This, however, does not greatly affect the apparent conditions, as the particles seen in cross section are in the minority and the general turbulence effects are demonstrated by those seen in longitudinal section.

In view of the behaviour of these particles, under the conditions experienced

during the moulding cycle, it becomes necessary to discuss the effects, if any, of this apparent orientation, on the strength of the finished moulding and a useful guide exists in the stresses set up in the material during the course of its reduction to a thin section. These stresses appear to occur in a direction at right angles to any grain which may exist, due to directional orientation of the filler, and although they are small there is sufficient force to cause the appearance of cracks in the structure, which, when examined in conjunction with the direction of the caused stress, shows the weakest spots in the structure.

In Fig. 278 one such crack is seen at D, the direction of the stress causing this rupture being from top to bottom of the illustration. The nature of the failure is interesting as it will be noticed that the crack follows the contour of a number of small particles and its curious "wavy" shape is clearly seen to be due to the position of the particles bordering it. In no case is it possible to detect the crack actually passing through a particle; in fact, it will be noticed that particle E is sufficiently strong to prevent the crack proceeding any further in this direction. Unfortunately, the termination at the other end of the crack is not clearly enough defined to enable any conclusion

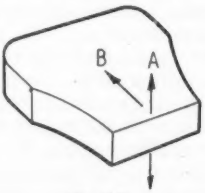

Fig. 279.

to be drawn. However, it appears that the crack originates at the resin-filler interface where the bond between the two materials is not of a high order of strength.

In view of this, and in this particular case, it becomes evident that the moulding in general, could be expected to be less strong in tension between the upper and lower surfaces than it would be in a direction along its long axis. Reference to Fig. 279 will clarify this point; thus in the sketch illustrating one half of the test piece, a tensile stress applied in the direction of the arrow A would presumably bring about failure of the material earlier than if the stress were applied in the normal direction as indicated by the arrow B.

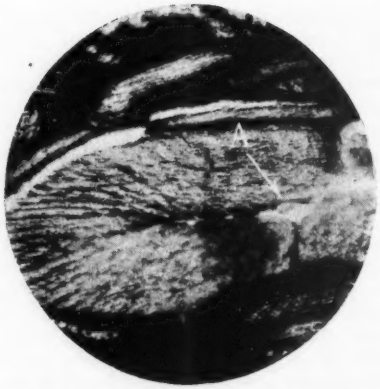

Fig. 280.—Section of flax shive-filled moulding showing fracture. Mag. 40 diameters.

The failure just discussed is seen to have occurred in conjunction with smaller particles, and as it would appear that the fracture occurs at the matrix-particle interface it is difficult to assess the parts played by the filler particle and resin as neither can be stated to have failed in itself, but rather should this be attributed to the adhesive forces between the two surfaces being inadequate.

Further evidence in support of this contention is shown in Fig. 280, illustrating a large fracture occurring along the contour of a very large particle. The magnification in this instance is 40 diameters. Here it is interesting to note that the gap is considerably wider than that shown in Fig. 278, for this latter at its widest point is no more than 0.01 mm., while the fracture shown in Fig. 280 is 0.75 mm. In view of the fact that the material would take a definite time to stabilize after the application of these stresses, it is probable that the larger of the two cracks commenced to form earlier

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than the other. If this be the case then we could assume that interfacial bonds occurring at points of large area, such as would be encountered in the surface of a large particle similar to that illustrated, would tend to be weaker than in cases where the area is small. Thus, in those cases where the nature of the filling material is such that the bond between the resin and filler is inherently weak, the presence of large particles would appear to be somewhat undesirable.

The particle shown in Fig 280 is cut somewhat obliquely to the transverse section; nevertheless it is evident that it is composed of a portion of a complete piece of shive consisting of a circular group of vascular bundles enclosing a

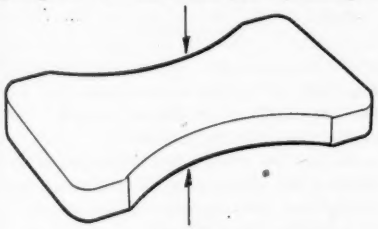


Fig. 281.

space which originally contained parenchymatous cells, and it is of interest to note that this space is still of appreciable dimensions and is also quite empty, in spite of the moulding temperatures and pressure employed to produce the specimen.

The foregoing remarks concerning the orientation of filler particles and the possible resultant effects on the strength of the moulding lead to interesting speculation regarding the strength of mouldings, and possible variations thereof produced by moulding technique. It has also been made clear that in this case there exists a strong tendency for the filler particles to orientate themselves in a horizontal direction, and, having done so, it is evident that the tensile strength of the material may be expected to vary according to whether it is applied in a direction which is parallel, or at right angles to the direction of orientation. Therefore, as in the first instance the specimen is

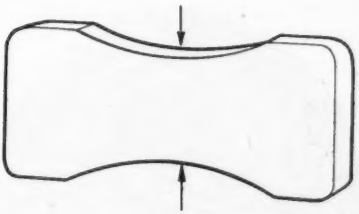


Fig. 282.

moulded in the horizontal position and with the moulding pressure applied in the directions indicated by the arrows in Fig. 281, it is reasonable to suppose that the orientation of the filler particle is a result of this moulding method.

As a result of this, it immediately becomes apparent that if the specimen were moulded on its side with the moulding pressures occurring in the directions indicated in Fig. 282, then the expected orientation of the filler particle would take place in a direction corresponding to the major axis of the specimen. Further, in view of the orientation due to moulding in the manner shown in Fig. 281 being in a direction similar to the minor axis of the specimen, a greater tensile strength may be expected of the specimen produced by moulding as shown in Fig. 282. However, more work remains to be done in this direction, and

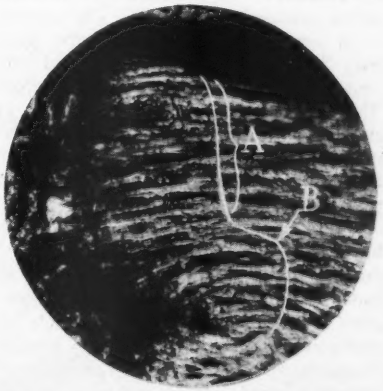


Fig. 283.—Section of flax-shive-filled moulding showing penetration of resin. Mag. 180 diameters.

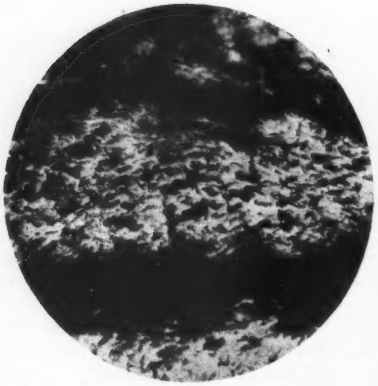


Fig. 284.—Moulding showing the flax shive particle in transverse section. Mag. 100 diameters.

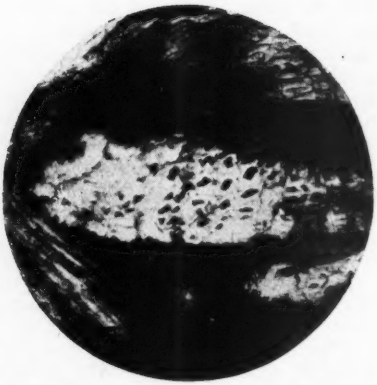


Fig. 285.—Flax shive particle, with thicker walled vessels, in transverse section. Mag. 100 diameters.

until results are available no definite conclusions can be arrived at.

In the particle shown in Fig. 280 there were signs of the penetration of the resin into the vessels; it is therefore expedient to examine the section further to elicit such information as is available on this point. In Fig. 283 we see a particle in this section at a magnification of 180 diameters; here it will be seen that a band of comparatively narrow depth A may be distinguished wherein the penetration of the resin into the structure of the particle may be seen. The particle is in longitudinal section and the resin may be seen to have penetrated the vessels for the short distance indicated. The longest distance of penetration in this case appears to be at the point marked B, and presumably a similar condition exists at the other end of the particle.

Thus, it will be seen in this particle we have a set of conditions tending to produce a most undesirable structure, at least insofar as its electrical characteristics are concerned, for the particle in question consists of a highly porous structure containing a considerable volume of air. This structure is sealed at both ends by the ingress of resin, and the air contained in it is trapped and no doubt is under an appreciable pressure, but there is no reason to doubt that this state of affairs exists throughout the filler in greater or lesser degree.

In the case of the specimen under discussion the resin was impregnated, and in view of the extensive use of pigments in powder formulations, it would seem likely that the presence of this latter constituent would tend to further reduce the penetration of the resin into the particles by virtue of the pigment particles clogging up the entry to the bores of the fibres. However, the problem at the moment is to elucidate the causes of poor penetration in the case of an unpigmented resin, such as that under consideration.

We know from our study of the fibres that the shive is the xylem tissue of the stem, and as such the vessels are of varying size, but their bores are relatively open; hence we may expect somewhat better penetration of the resin than in reality exists. Therefore we must ask ourselves the basic reason underlying this phenomenon, because, in view of the length of the particle seen, it would seem highly improbable that the penetration of the resin would be brought to a halt by the trapped air being under the same pressure as the resin surrounding the

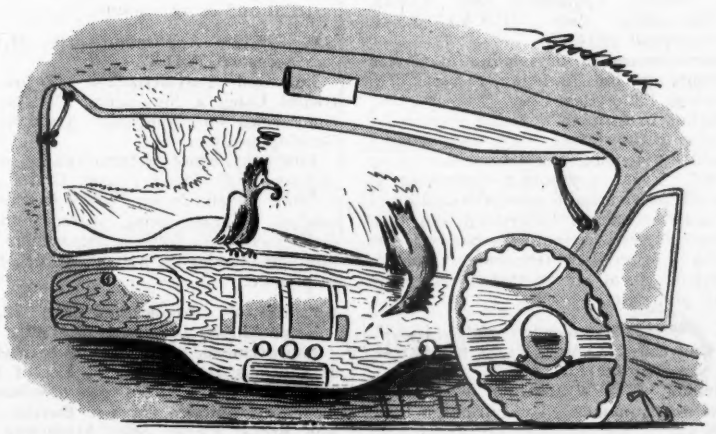
particle. In the light of this, it would seem to be more likely that other factors combine to produce this condition. Thus, on the one hand it is not beyond the bounds of possibility that the combined effects of temperatures and pressure bring about immobility of the resin before it has had time to penetrate the structure any farther than indicated. On the other hand, it will be appreciated that much the same sort of effect could be produced by a collapse of the structure of the filler particle.

A study of particles in transverse section, however, tends to show that a combined effect of the two possibilities is the more probable cause. Thus, in Fig. 284 we see a particle in cross-section at a magnification of 100 diameters. Here the majority of the vessels are still fairly open, although general collapse of the structure plainly exists to a considerable extent; so much so that it is very doubtful whether this collapse would have stopped at this stage if there had not been a solid plug of resin present to prevent it, signifying that the resin solidified in the vessels at some period after they had commenced to collapse.

At the same time, it should be remembered that on the application of the moulding pressure the particle would be flattened, thus compressing the air contained in the vessels, and assuming that the particle is by now surrounded by resin which has liquefied, a point would soon be reached where the internal and external pressures would be balanced. We now have to admit that further consideration of the problem brings the original theory concerning the effects of air pressure very definitely into the picture, so that there are three possible contributory causes which are capable of producing the same result, either independently or together. In practice, however, it is probable that structural differences in the filler particles will have a modifying effect on one or more of these factors.

Fig. 285 shows another particle which possesses thicker-walled vessels than in the previous case, and it is plainly seen that the degree of collapse is not so great in the majority of the elements. This results in the bore being open to a greater extent, but in spite of this a study of the section shows that in such cases there does not appear to be any greater depth of penetration of the resin.

(*To be continued.*)



[*With acknowledgement to "The Motor."*]

PATENT REVIEW

The following abstracts have been made from specifications at the Patent Office, with the permission of the Controller of H.M. Stationery Office. Complete specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each.

B.P. 594,993. Application date: 9.4.45. (Divided out of B.P. 594,985.) Accepted: 24.11.47.

Improvements in or relating to Machines Adapted for Seaming together two work-pieces by use of a high-frequency electric field. To: The British United Shoe Machinery Co., Ltd.

B.P. 595,005. Application date: 8.1.45. (Addition to B.P. 558,100.) Accepted: 25.11.47.

Improved Adhesive Composition. P. Frankfurter.

Aqueous emulsion comprising a polyvinyl acetate, a natural resin and a softener for polyvinyl acetate, emulsified in a quantity of water exceeding 25 per cent. of the weight of the emulsion.

B.P. 595,056. Application date: 13.4.42. Accepted: 26.11.47.

Production of Complex Esters and their Polymers. To: Pittsburgh Plate Glass Co.

Preparation of polyesters by reacting one molecular proportion of an aliphatic dihydroxy compound (diethylene glycol) with two molecular proportions of an acid ester of a dicarboxylic acid or acyl chloride thereof (phthalic acid) and an unsaturated monohydric alcohol (allyl, methallyl or chlorallyl alcohol).

B.P. 595,057. Application date: 23.4.42. Convention date: (U.S.A.) 6.5.41. Accepted: 26.11.47.

Improvements in or relating to Coated Polymers and the Formation thereof. To: Pittsburgh Plate Glass Co.

Method of forming a coated polymer by applying to the surface of the base material formed by incomplete polymerization of an organic oxygen compound containing at least two polymerizable groups, a coating of the same or similar compound and then further polymerizing both the base and the coating materials. (Examples quoted: diethylene glycol bis (methallyl carbonate) diallyl phthalate).

B.P. 595,058. Application date: 16.6.42. Convention date (U.S.A.): 16.6.41. Accepted: 26.11.47.

Method of Polymerizing Unsaturated Organic Compounds. To: Pittsburgh Plate Glass Co.

Polymerization of organic oxygen compounds containing at least two unsaturated polymerizable groups (ethylene glycol bis (allyl carbonate)) by partially polymerizing the compound to form a gel, releasing the internal strains in the gel, followed by further polymerization.

B.P. 595,065. Application date: 27.6.44. Convention date (Switzerland): 28.6.43. Accepted: 26.11.47.

Process for the Production of Water-soluble Condensation Products and the Resulting Products. To: J. R. Geigy A.G.

Water-soluble products made by the condensation of an N : N'-bis- [1 : 3 : 5-triacinyl-(6)] derivative of 4 : 4'-diaminostilbene-2 : 2' disulphonic acid (the triazine rings containing at least one free amino group) with a neutral or alkaline solution of formaldehyde.

B.P. 595,092. Application date: 24.4.45. Convention date (France): 19.6.44. Accepted: 26.11.47.

Improvements in Cellulose Plastics diffusing Light and Processes for Manufacturing the same. To: Société des Usines Chimiques Rhône-Poulenc.

Plastic composition comprising a basic cellulosic material (acetone soluble cellulose acetate) and distributed throughout the mass of this material a secondary cellulosic material (a cellulose ether or ester) having a different refractive index than the base material and being insoluble in acetone.

B.P. 595,120. Application date: 15.10.43. Accepted: 27.11.47.

Improved Polymerization Process for Olefins Using a Slow-acting Catalyst. A Communication from the Standard Oil Development Co.

Low-temperature polymerization of iso-olefines employing a Friedel Crafts metal bromide in solution in a lower paraffin, the catalyst solution being stirred into the olefin mixture to form a homogenous mixture and allowing the polymerization process to proceed.

B.P. 595,140. Application date: 28.11.44 and 23.3.45. Accepted: 27.11.47.

Improvements in or relating to Methods of Shoemaking involving the Use of High-frequency Electric Fields or in or relating to Apparatus Suitable for Use therein. To: The British United Shoe Machinery Co., Ltd.

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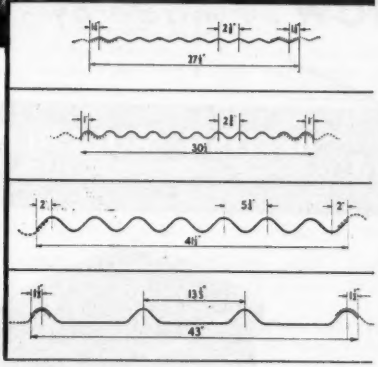

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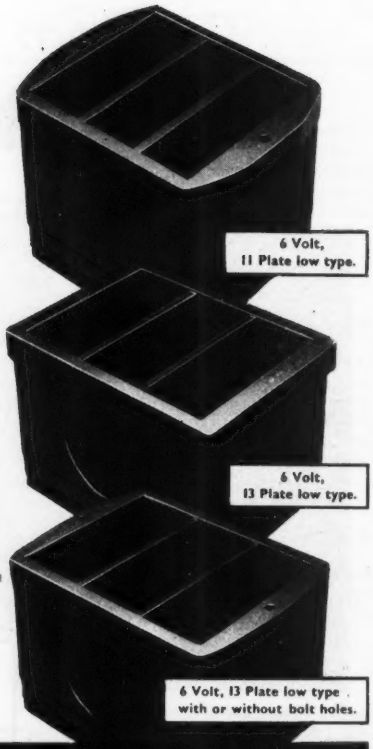

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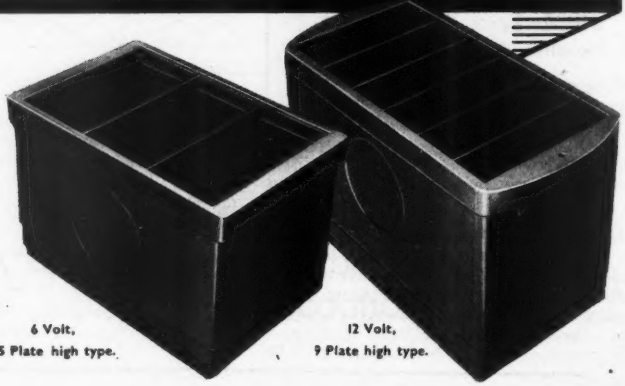


B.M.112.

Method of stiffening a selected portion of a shoe-upper by incorporating a stiffening means in the selected portion, performing a shaping operation on the selected portion and subjecting it subsequently to the heating action of a high-frequency field.

B.P. 595,180. Application date: 26.8.43. Convention date (U.S.A.): 1.8.42. Accepted: 28.11.47.

Improvements in or relating to Synthetic Resins. J. T. Thurston. To: American Cyanamid Co.

Alpha-furyl substituted organic sulphonate condensed with an aldehyde and insolubilized by heating the resulting gel. These resins may be used in reduction processes (to reduce cations to their metallic state), and also as cation exchangers.

B.P. 595,208. Application date: 3.4.45. Convention date (U.S.A.): 24.11.43. Accepted: 28.11.47.

Method of Making Furfuryl Alcohol Resinous Products and the Resulting Products. To: Haveg Corporation.

Preparation of furfuryl alcohol resins which can be converted into a completely condensed and polymerized product by mixing with an initial furfuryl alcohol resin (insufficiently acid to be convertible during working) an amount of a latent catalyst which is neutral or only slightly acid at room temperature and therefore inactive during the working period, but effective thereafter by liberating strong acid, causing condensation and polymerization of the resins.

B.P. 595,257. Application date: 7.10.44. Accepted: 1.12.47.

Improvements in and relating to the Manufacture of Products comprising Fragmentary Wood Material Bounded with Synthetic Resins. P. Wilderman.

Manufacturing process for panels, slabs or sheets resembling natural wood, by treating wood fragments with a bonding solution containing a thermosetting resin, moulding the mixture into panels, sheets, etc., curing under application of heat and pressure, taking care that the pores are not closed, and applying to the panels, sheets, etc., after cooling a bonding material which penetrates into the pores and forms a water insoluble, transparent, or translucent surface.

B.P. 595,288. Application date: 28.6.45. Convention date (Switzerland): 29.6.44. Accepted: 1.12.47.

Process for the Production of Cast Resin. To: Gesellschaft zur Förderung der Forschung auf dem Gebiete der Physik. (E.T.H.)

Production of cast resins by mixing a phenol formaldehyde condensation product which is liquid at room temperature with an acid (hydrochloric acid) and furfurol. The mixture is subsequently cast into moulds.

B.P. 595,290. Application date: 2.7.45. Convention date (U.S.A.): 1.7.44. Accepted: 1.12.47.

Adhesive Compositions. To: E. I. Du Pont De Nemours and Co.

New adhesive compositions comprising a copolymer of butadiene or isoprene and a vinyl pyridine together with 10 per cent. to 90 per cent. of a heat convertible phenol-aldehyde resole (resorcinol-formaldehyde).

B.P. 595,338. Application date: 27.3.45. Accepted: 2.12.47.

An Improved Manufacturing Method of Phenol-Formaldehyde Resinous Compositions. E. H. Sargent.

Manufacture of Phenol-formaldehyde sheets and articles in bright or light colours, by mixing a phenol-formaldehyde resin in the heat reactive state with polyvinyl chloride, a chlorinated diphenyl (arochlor) and a pigment, late or dyestuff, and heating the mix to convert the resin to its infusible state. Fibrous materials (paper, cotton, woven glass or asbestos) may be impregnated with the liquid resin mix for the manufacture of laminated sheet.

B.P. 595,350. Application date: 14.3.42. Accepted: 3.12.47.

Improvements in the Production of Protective Films and Fabrics and Articles made therefrom. G. Stansfield and S. Mills. To: Chemical Defence Research Dept. (Ministry of Supply).

Protective means resistant to penetration by noxious or injurious gases, liquids or vapours, comprising a thin film from polyisobutylene, covered on one or each side with a layer of rubber or rubber-like compound.

B.P. 595,366. Application date: 20.11.44. Convention date (U.S.A.): 20.11.43. Accepted: 3.12.47.

Synthetic Resinous Materials and Process of Making same. To: The Resinous Products and Chemical Co.

Relates to a new kind of nitrogenous thermosetting resin prepared by condensation of aldehydes (formaldehyde) with carbamides (urea) and/or amino-azines containing salt-forming sulphonate groups (melamine).

B.P. 595,367. Application date: 21.11.44. Convention date (U.S.A.): 20.11.43. Accepted: 3.12.47.

Resin Containing Paper or Paper Board.

To: The Resinous Products and Chemical Co.

Manufacture of high wet strength paper by adding to the paper stock prior to formation into webs a water-soluble thermosetting resin of the formaldehyde-melamine type described in B.P. 595,366.

B.P. 595,368. Application date: 22.11.44. Convention date (U.S.A.): 22.11.43. Accepted: 3.12.47.

Process of preparing Resinous Condensation Products having Ion Sorbing Properties and Products obtained thereby. To: The Resinous Products and Chemical Co.

B.P. 595,447. Application date: 3.12.43. Accepted: 5.12.47.

Improvements in or relating to the Manufacture of Synthetic Resins. J. J. P. Staudinger, D. Faulkner and M. D. Cooke. To: The Distillers Co., Ltd.

Refers to the copolymerization of halogen containing ethenoid compounds with esters or ether-esters containing both a glycidyl radicle and an unsaturated aliphatic group by subjecting their mixture to heat and/or actinic light in the presence of a peroxide catalyst.

B.P. 595,505. Application date: 5.4.45. Accepted: 8.12.47.

Improvements in Toy Building Blocks. H. Hems.

B.P. 595,512. Application date: 17.5.45. Accepted: 8.12.47.

Improvements in or relating to Packages. A. G. Rose. To: Rose Brothers (Gainsborough), Ltd.

B.P. 595,550. Application date: 27.7.43. Convention date (U.S.A.): 30.7.42. Accepted: 9.12.47.

Improvements in and relating to Resinous Reaction Products of Aldehydes and Triazine Derivatives. To: British Thomson-Houston Co., Ltd.

B.P. 595,551. Application date: 9.12.43, 28.11.44. Accepted: 9.12.47.

Improved Polymerization Process. J. J. P. Staudinger and M. D. Cooke. To: The Distillers Co., Ltd.

Emulsion polymerization of vinyl chloride and/or vinylidene chloride.

B.P. 595,567. Application date: 11.6.45. Convention date (France): 21.6.44. Accepted: 9.12.47.

Improvements in or relating to the Manufacture of Films and Foils from Polyvinyl Resins. To Société des Usines Chimiques Rhône-Poulenc.

Manufacture of flexible films of polyvinyl acetal (polyvinyl formaldehyde acetal or polyvinyl butyraldehyde acetal) by coating a moving endless belt with cellulose triacetate dope, drying the resulting film, casting a polyvinyl acetal solution on to the film, evaporating the solvent by drying and finally stripping from the band the combined films.

B.P. 595,569. Application date: 28.6.45. Convention date (U.S.A.): 29.6.44. Accepted: 9.12.47.

Improvements in and relating to Pressure-sensitive Adhesive Masses. To: Johnson and Johnson (Gt. Britain), Ltd.

Pressure-sensitive mass, comprising polyisobutylene, a tackifying resinous material and a factice.

B.P. 595,571. Application date: 6.7.45. Accepted: 9.12.47.

New colouring Matters for Cellulose Esters and for Fibre-forming Polyamides and Polyesters. D. W. Stammers. To: Imperial Chemical Industries, Ltd.

Refers to oxindole colours of greenish yellow to orange shades.

B.P. 595,576. Application date: 6.7.45. Accepted: 9.12.47.

Improvements in the Manufacture of Artificial Flowers. J. Veit and J. F. Kenure.

Artificial flowers made by injection moulding from plastic materials.

B.P. 595,607. Application date: 28.9.44. Convention date (U.S.A.): 13.9.43. Accepted: 10.12.47.

Continuous Process for the Manufacture of Synthetic Resins. To: The Girdler Corp.

B.P. 595,608. Application date: 29.9.44. Accepted: 10.12.47.

Applying Protective Coating to Surfaces. C. F. Lumb.

Coating or impregnating of articles by spraying with sulphur and synthetic resins in a finely divided state. The sprayed material is subjected to heat whilst being sprayed to render the material plastic and to cause adherence to the base.

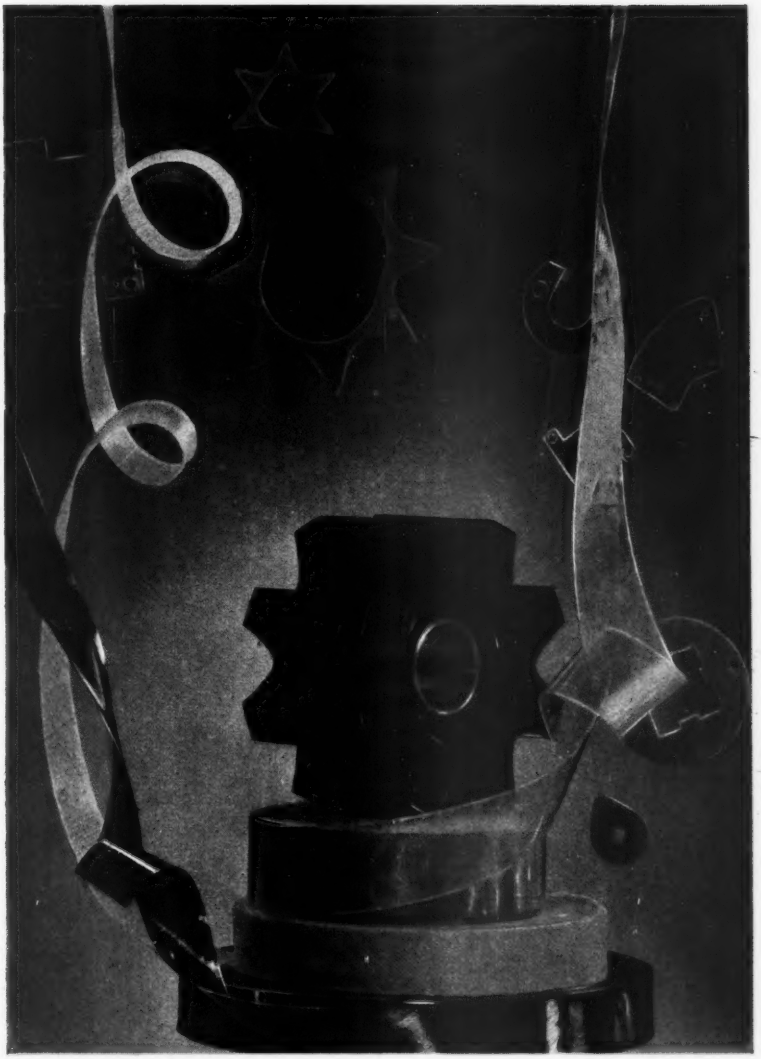
B.P. 595,611. Application date: 15.11.44. Accepted: 10.12.44.

Improvements in Closures or Stoppers for Bottles or like Containers. J. A. Torpey.

B.P. 595,629. Application date: 5.7.44. (Patent of addition to B.P. 570,840.) Accepted: 11.12.47.

Improvements in or relating to the Manufacture of Compound Sheet Materials. J. H. McGill. To: Imperial Chemical Industries, Ltd.

B.P. 595,632. Application date: 29.9.44. Accepted: 11.12.47.



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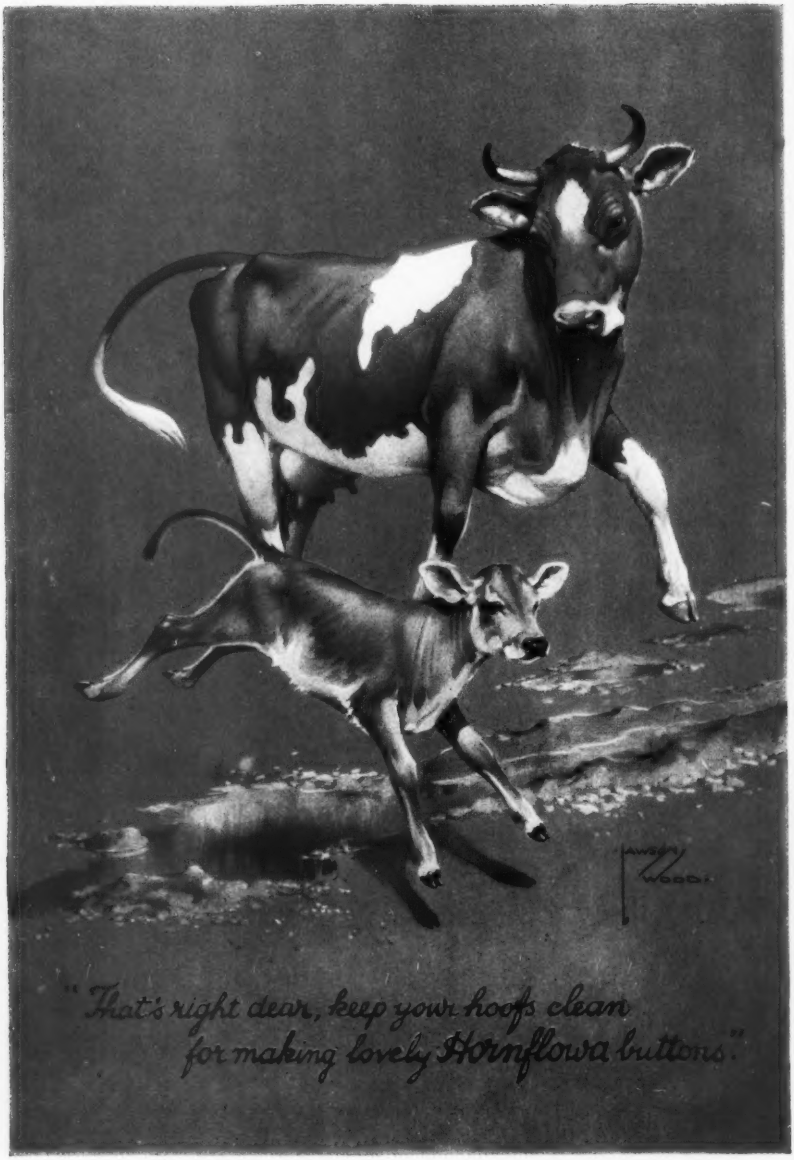

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Improvements in or relating to the Manufacture of Compound Sheet Materials. J. H. McGill and J. W. Nash. To: Imperial Chemical Industries, Ltd.

B.P. 595,650. Application date: 7.6.45. Accepted: 11.12.47.

Moulding Machines for Plastics and other Mouldable Materials. W. S. Renier.

B.P. 595,667. Application date: 19.4.44. Convention date (U.S.A.): 20.4.43. Accepted: 15.12.47.

Mechanically Stabilized Shapes of Polystyrene and the like and Method of Producing such Shapes. To: Plax Corporation.

Production of stable polystyrene articles (i.e., articles which will not crack nor craze) by heating these articles for a short time to at least their transition temperature and cooling at a controlled rate, leaving residual stresses in the article of not more than 150 lb. per sq. in. and preferably less.

B.P. 595,701. Application date: 18.5.45. Accepted: 12.12.47.

Composite Material for Use in Structural Work and its Mode of Manufacture. C. H. Buchanan. To: Tiewood, Ltd.

B.P. 595,734. Application date: 17.4.45. Accepted: 15.12.47.

Improvements in or relating to Synthetic Resins. D. N. Davies and F. S. Deutsch. To: Cellomold, Ltd.

Resorcinol-formaldehyde resin and cold-setting adhesive made therefrom.

B.P. 595,754. Application date: 9.8.44. Convention date (U.S.A.): 4.8.43. Accepted: 16.12.47.

Improvement in Resin-coated Fibre Base and Process of Making. F. W. Duggan. To: Carbide and Carbon Chemicals Corp.

Composite material, comprising a porous and flexible fibrous base, a vinyl resin obtained by copolymerization of maleic acid and a vinyl halide, impregnating the fibrous base and a cover layer consisting of or containing a substantially insoluble resin containing vinyl chloride.

B.P. 595,757. Application date: 23.9.44. Convention date (U.S.A.): 23.9.43. Accepted: 16.12.47.

Improvement in Process for Making Styrene. C. L. Shriver. To: Carbide and Carbon Chemicals Corp.

Production of styrene by dehydration of phenylmethyl carbinol in the vapour phase in the presence of titania as a catalyst.

B.P. 595,758. Application date: 23.10.44. Convention date (U.S.A.): 2.10.43. Accepted: 16.12.47.

Production of Resin. L. N. Whitehill and F. A. French. To: Shell Development Co.

Refers to copolymers of diallyl tetrachlorophthalate with diallyl phthalate.

B.P. 595,759, 595,760, 595,761, 595,763, 595,765, following, relate to the direct conversion of coal into plastics and plastic products:—

B.P. 595,759. Application date: 2.11.44, 21.12.44, 29.12.44, 9.1.45, 22.1.45, 12.2.45, 28.2.45. Accepted: 16.12.47.

Improvements in or relating to the Production of Useful Articles from Coal. J. G. Bennett, M. Pirani, W. J. Kramers, D. B. Foster, G. C. Phillpotts and C. D. Greaves. To: C. D. Patents, Ltd.

B.P. 595,760. Application date: 22.12.44, 9.1.45. Accepted: 16.12.47.

Improvements in or relating to the Production of Useful Articles from Coal. J. G. Bennett, M. Pirani, W. J. Kramers, D. B. Foster, G. C. Phillpotts and C. D. Greaves. To: C. D. Patents, Ltd.

B.P. 595,761. Application date: 8.11.45. Accepted: 16.12.47.

Improvements in or relating to the Production of Useful Articles from Coal. J. G. Bennett and C. D. Greaves. To: C. D. Patents, Ltd.

B.P. 595,763. Application date: 3.1.45. Accepted: 16.12.47.

Improvements in or relating to the Production of Useful Articles from Coal. J. G. Bennett, M. Pirani, C. D. Greaves and A. Buirski. To: C. D. Patents, Ltd.

B.P. 595,765. Application date: 26.1.45. Accepted: 16.12.47.

Improvements in or relating to the Production of Useful Articles from Coal. J. G. Bennett and C. D. Greaves. To: C. D. Patents, Ltd.

B.P. 595,771. Application date: 28.3.45. Convention date (France): 13.5.42. Accepted: 16.12.47.

Improvements in or relating to the Preparation of Aryl Sulphonyl Thioureas. To: Société des Usines Chimiques Rhône-Poulenc.

B.P. 595,841. Application date: 27.9.44. Accepted: 18.12.47.

Method and Means for Making a Foot Arch Support. W. M. Scholl. To: The Scholl Mfg. Co., Ltd.

QUALITY CONTROL IN PLASTIC MOULDING

(*Continued from page 207.*)

Red or green plottings would only be inserted in the chart if and when a marked tendency to deviate was observed from the component checking. This provision would prove a great guidance to the mould setter, who eventually might be called in to readjust or alter a mould. If desired, of course, the control charts could be modified in such a way as to embrace separate control datums for both weight and surface finish, but this would prove to be an almost unnecessary complication of the charts for this simple moulding job and, in any case, explanation of the method of constructing such a chart forms the subject matter of a succeeding instalment.

In conclusion it is emphasized that, with the quality controlling of hand-operated moulds of the type considered in this article, one of the chief production factors liable to vary is the operator of the tool. Because of this, it is very essential that he be instructed in the very best way to operate the tool and steps taken to ensure that he institutes no unauthorized variation in the method of handling or working the tool. Such developments would be liable completely to upset the relationship of the control charts in use and give misleading results.

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Leaves from a Moulder's Notebook

This is the seventeenth in a series of notes by the B.I.P. Development Department on the problems of the moulder and designer. Nos. 1 — 12 in this series are now available in booklet form and B.I.P. will be pleased to send a copy of this and subsequent notes on request. Comments and enquiries are welcome.

The next "Leaves from a Moulder's Notebook" will be published in June.

Flash

Close attention to detail can be far more profitable than is often realised. The correct provision of means for the escape of flash is one such detail which will repay in abundance the time spent on it. It is not enough merely to ensure sufficient clearance for flash and trust to the moulder to remove any that adheres to the mould at the end of each cycle. Precious seconds, even minutes in extreme cases, can be spent in removing such flash between extraction and loading, with no guarantee that the flash will be effectively removed.

In the first place it is obvious that flash can be cleared from a die or bottom tool more readily than from a punch or top tool. On semi-positive moulds, therefore, where the practice often is to incorporate integral pressure pads in the machining of the mould they should be machined on the die and not on the punch (see Fig. 1). Secondly, a high polish and, if possible, chromed punch shank having a radius in the corner (see X on Fig. 2) will go a long way towards reducing to a minimum the time that must be spent in removing flash. The spew escape grooves in the pressure pads should be cut with a large radius and ample space for flash flow should be left between the punch and die (see A on Fig. 2).

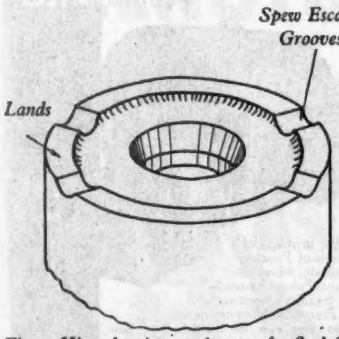

Fig. 1 *View showing ample space for flash flow*

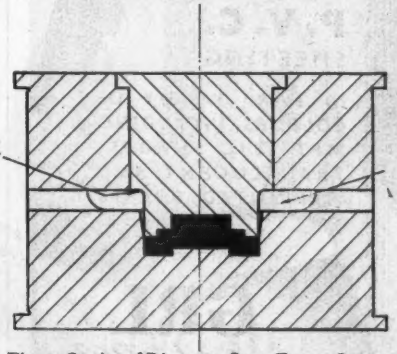

Fig. 2 *Section of Die across Spew Escape Grooves*

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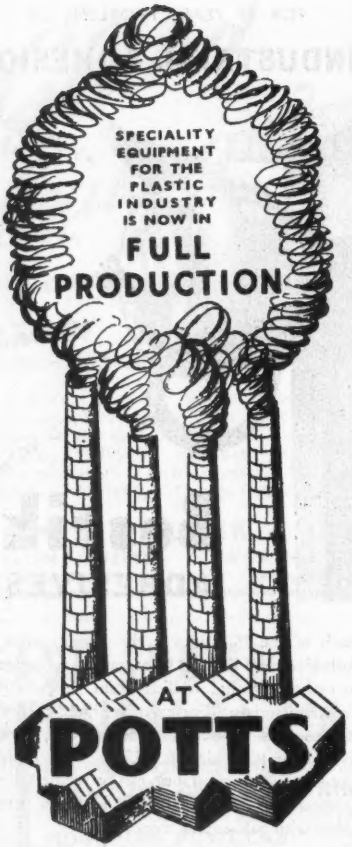

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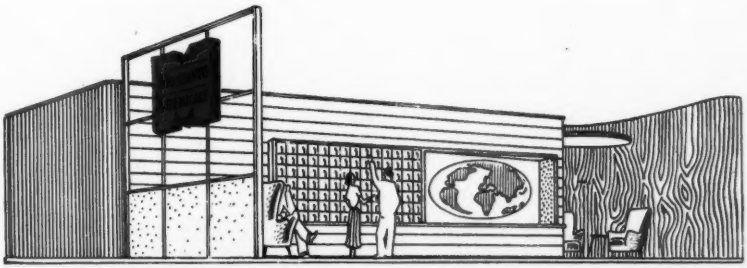

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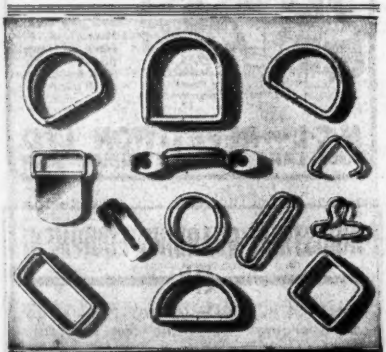

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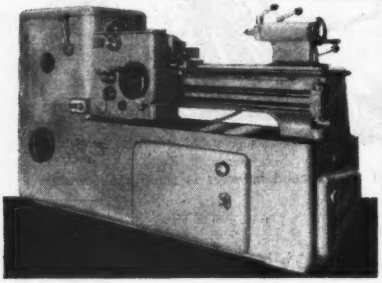

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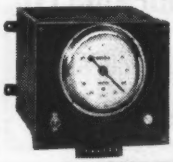

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Mouldders of low-priced plastic novelty of universal appeal invite inquiries from agents capable of handling large quantities and export orders. Ferrand-Luttmer Plastics, Ltd., Havelock Close, Felpham, Bognor Regis. 131-47

"Impossible" moulding propositions invited by pioneer injection moulders with unusually qualified staff and most modern capacity up to 12 oz. Inquiries in strict confidence and without obligation. Box 1241, care of "Plastics." 131-40

Production capacity available for fabricating plastics, adequate stocks Perspex and tool-room facilities available. Inquiries welcomed. Box 2447. care of "Plastics." 131-x5080

Capacity available on 40-100-ton compression presses. Tools quoted if not available. Box 2732. care of "Plastics" 132-5702

Australian Plastics Industry.
Director of an Australian injection moulding Company now in England invites inquiries from manufacturers wishing to arrange associations with Australia for powder, machines, purchase or hire of moulds and ideas generally. Ring or write for appointment to, C. N. M. Walker, care of Messrs. Ogden, Hibberd, Bull and Langton, Audrey House, Ely Place, London, E.C.1. 132-5700

Inquiries invited for diecasting tools, press tools and for precision milling and jig boring. Hornflowa, Ltd., Maryport, Cumberland. 132-5696

—RAW MATERIAL AVAILABLE AND WANTED—

Catalin off-cuts and scrapped material for sale. A Kahn, 41 Kennington Lane, S.E.11. 132-x5183

For sale, clear Perspex, coloured acetate tube, rod, sheet. E. and H. Grace, Ltd., 125a Hamilton Road, London, S.E.27. 131-x5607

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THE STOCKISTS OF SHEETS, RODS, TUBES, OFF-CUTS AND SCRAP.
OFFER OTHER LINES WHICH CAN BE USED IN COMBINATION WITH PLASTICS.
UTILIZING ANIMAL AND VEGETABLE PRODUCTS.
Such as tortoiseshell, horn, cleaned and prepared cattle bones for industrial purposes, vegetable ivory nuts, porcupine quills, goose and duck feathers, and barrels, etc.
S. R. F. FREED, LTD.,
27b HIGH STREET, SOUTH NORWOOD. S.E.25.
Phones, Livingstone 4042; Sanderstead 2056. zzz-462

Perspex for sale, new sheets offcuts, large and small scrap, powders; clear and colours. Box 9024, care of "Plastics." 131-5305

Moulding powders. If you have any redundant stocks for disposal contact us and also give us your inquiries if you are in need of supplies of other powders. Box 9756, care of "Plastics." 131-5304

Body for ceramics, floorings, modelling, refractories, etc. Suppliers, Dohm, Ltd., 167 Victoria Street, London, S.W.1. 133-4969

1st quality virgin cellulose acetate moulding powder available. Box 3184, care of "Plastics." zzz-213

Polythene moulding powder (reconstituted) in black, natural and a variety of colours. Dohm, Ltd., 167 Victoria Street, London, S.W.1. zzz-212

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TRANSPARENT AND COLOUR.
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Central 5947.
Call if possible 9 to 6 Closed Saturdays. 134-05309

Acetate cellulose sheeting wanted to purchase for cash, transparent or coloured up to 30 thou. thick, any size or quantity, send samples with details. Allans, 37 Farringdon Street, London, E.C.4. Central 5947. 132-04013

Perspex tubing. We can now supply welded Perspex tubing from ¼ bore upwards. Inquiries invited. Evolite Plastics, Ltd., 325 Latimer Road, W.10. Phone, Lad 1879. 135-5704

Perspex I.C.I. acryl'c sheeting. Official stockists offer services which include cutting to size, edge polishing and tinting; also Crinothene for lampshades, handbags, etc. Stock and price lists from Almex, Ltd., 78 Exchange Buildings, Birmingham, 2. 139-4971

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Phone, Victoria 9182-3. 132-4266

Large quantities of clean polythene white, black and other colours, segregated. Box 2028. care of "Plastics." zzz-202

Raw Material Available and Wanted (contd.)

P.V.C. scrap and off-cuts wanted. We are large buyers of all types, particularly opaque colours. Please submit samples and offer, stating quantity, etc., to Box 3193, care of "Plastics." 131-4

Extruders of P.V.C. belting and sleeving are invited to communicate with advertisers who require substantial and regular supplies. Box 3194, care of "Plastics." 131-2

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Metal powders and oxides. Quotations and samples on application. Dohm, Ltd., 167 Victoria Street, London, S.W.1. zzz-410

Regular supplies of imported phenolic and urea powders, polystyrene and cellulose acetate injection powders. Inquiries, Box 1211, care of "Plastics." zzz-454

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Phone, Archway 4014-5. 131-3

Scrap. Why not let a well-established firm quote you for cellulose acetate, polystyrene, P.V.C. cuttings and other thermoplastic off-cuts and scrap? Having best use for these materials, highest prices can be paid. Quotations on receipt of representative samples to M. H. Grist (Plastics), Ltd., 82-84 Brighton Road, Surbiton, Surrey. Phone, Elmbridge 4214. zzz-457

P.V.C. strippings from cables, thoroughly cleaned, black, brown, red, yellow, blue, etc. Segregated. Large quantities, 1s. 3d. lb.
John Walton and Co. (Castleside), Ltd., Metalex Works, Gt. Cambridge Road, Enfield. Phone, Enfield 3425. zzz-458

Transparent packaging of all types; lipstick, refill containers, ex stock. Modern Plastics, Ltd., Kangley Bridge Road, S.E.26. 131-5303

Wanted, plastic waste and plastic piece goods. Send particulars, stating quantity and price. Box 2382, care of "Plastics." zzz-468

Transparent wrapping film wanted, sheets 10-in. by 8-in. upwards, or reels 4-in. upwards, any quantity, for cash, send sample and details. Allans, 37 Farringdon Street, E.C.4. Central 5947. 135-5697

3,000 single tier chrome units suitable for egg cup stands. Samples and prices, O-Ess Products, Ltd., Newport, Mon. 131-9

Several cwt. of P.V.C. waste for sale. Samples on application. Write to Leathercraft, Ltd., 72-74 Merton Road, Watford, Herts. 131-13

Stock, 6 tons black and 2 tons brown phenol formaldehyde, excellent quality. Full particulars and immediate delivery from Dunbee, Ltd. 10 Union Court, Wormwood Street, London, E.C.2. 131-18

Aluminium flat and corrugated sheets. Corrugated Perspex roof lights. Flat Perspex. List free. Henry Moat and Son, Ltd., Atom Works, Newcastle. 131-19

Cellulose acetate scrap for sale. Box 3211, care of "Plastics." 131-22

P.V.C. chips. Recompounded material manufactured from best grade extrusions. Perfectly clean and ready for use. Large quantities black and red shortly available. Inquiries to Box 3209, care of "Plastics." 131-24

For disposal, surplus stocks of cellulose acetate moulding powder, various colours. Prices and samples on application. Box 3347, care of "Plastics." 131-31

Raw Material Available and Wanted (contd.)

D. H. Ridout and Son, Ltd., registered office 12 Stedman Road, Southbourne, Bournemouth, phone Southbourne 505, offer:—
New Perspex sheet, 72 ins. by 24 ins. by 5/32 in., 66s. sheet; 50 ins. by 12 ins. by 5/32 in., 24s. sheet; 23¾ ins. by 17 ins. by 3/16 in., 20s. sheet. All paper covered.
Perspex scrap, crystal and amber, all gauges, good-sized pieces, 1s. 3d. to 2s. lb., according to gauge and quantity required.
Ribbed plastic belting, 1¼ in. wide, green and beige, 6d. yd.
Plastic panelling in sheets, 96 ins. by 48 ins. by 1/16 in. or ⅛ in., suitable caravans or partitions, from 48s. sheet.
Transparent acetate sheeting, .007 in. thick, 3s. 6d. lb. Same material, .010 in., 4s. lb.
Opaque tangerine acetate sheets, 48 ins. by 21 ins. by 2 mm., new material, paper interleaved, 25s. sheet.
Clear emerald acetate sheets, 50 ins. by 20 ins. by ⅛ in., new material, paper interleaved, 35s. sheet.
Crystal acetate sheets, 2 mm., 3 mm., 4 mm., 5 mm., at 5s. 6d. lb. Discount for quantities.
Plastic door furniture, complete with locks, at keen prices.
Numerous crystal and amber squares, discs, etc. Suitable for pocket torches, toys, etc. All new material, 3s. lb. Samples on request.
Plastic screw-top bottle caps, jam covers, shaving soap cases, powder boxes, lipstick holders, etc., for home and export market. Inquiries invited. All prices ex works. 131-25

For disposal, surplus stock of Warerite sheeting. Pink, green, cream, blue, standard sizes. J. E. Snow (Plastics), Ltd., 72 Arundel Street, Sheffield, 1. 131-32

Several thousand tons Bauxite residue ex aluminium manufacture for disposal, near Newcastle. Box 3345, care of "Plastics." 131-33

A new moulding plastic for repetition casting plaster of paris, cement, resins, etc., finest detail. Tough, highly flexible, can be remelted and used repeatedly. Send for reprint of illustrated article on "Vinamold" in "Plastics." Vinyl Products, Ltd., Carshalton, Surrey. 131-36

Perspex acrylic sheet. Ensure quick delivery, one of the largest stocks in the country at your service, complete range of colours 1/16-in. to ½-in., recognized stockholders. J. H. Berry, Plastics, Portland Works, Annesley Woodhouse, Notts. 131-38

UNIQUE OPPORTUNITY.

25 tons cellulose acetate BUTYRATE TENITE II medium flow for disposal, virgin black, first grade special quality 3s. 3½d. per lb. EX STOCK, London (send for sample).
60 HEATH DRIVE.
GIDEA PARK,
ESSEX.
Phone, Romford 5027. 131-x7435

Wanted to buy, P.V.C. sheeting remnants, plain and printed: also sub-standard printed P.V.C. sheeting. Box 3129, care of "Plastics." 131-x7130

Phenol moulding powder, black, Home market, ex stock. 2s. 3d. lb. Box 3149, care of "Plastics." 131-x7209

Transparent cellulose acetate moulding powder, any colour, prompt delivery, Home market, 4s. 3d. lb. Box 3150, care of "Plastics." 131-x7209

300 sheets clear green cellulose acetate, 50 ins. by 20 ins. by ⅛ in., new material interleaved, 30s. per sheet, inspection in London. M.B.S., 315 Cann Hall Road, Leytonstone, E.11. 131-x6441

Polythene cable strippings, moulding scrap and foil urgently required, state amount available and send small sample. Box 3186, care of "Plastics." zzz-217

Buna-plast, a blending of synthetic rubber and P.V.C. specially processed for manufacturing leather substitute; this material is far superior to plasticized P.V.C., inquiries welcomed. Dohm, Ltd., 167 Victoria Street, London, S.W.1. zzz-216

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POLYSTRENE, etc., etc.
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143 CANNON STREET, LONDON, E.C.4.
Phone, Mansion House 1270. 131-51

Raw Material Available and Wanted (contd.)

Moulded plastic trays, blue and cream, 4,000 available, sizes 15 by 10 and 17 by 11½, designed if required, for clearance in one lot. Box 2315, care of "Plastics." 131-50

Perspex wanted. Large quantities of full sheets in ⅛-in. coloured (all pastel shades). Must be at least 25 per cent. under I.C.I. list price. Box 3364, care of "Plastics." 131-48

P.V.C. calendering compound in a range of opaque colours. Dohm, Ltd., 167 Victoria Street, London, S.W.1. zzz-215

Polystyrene moulding scrap urgently required, state amount available and send small sample. Box 3185, care of "Plastics." zzz-214

P.V.C. sheeting, thickness .020 in., size 28 ins. by 28 ins., in ripple and water grain finish. Large selection of colours available. Please send for stock list to Box 2850, care of "Plastics." 131-44

Cellulose acetate sheeting, transparent, blue matt/polished, thickness .040 in., size 49 ins. by 21 ins., 52 sheets. Box 2846, care of "Plastics." 131-43

Wanted, thermoplastic moulding powders and moulding scraps, all kinds. Offers and samples to Alfa Plastics, Ltd., 20-21 St. Dunstan's Hill, E.C.3. 131-39

Catalin beads, ½ in. square. Very good assortment in many attractive colours. Write, Box 2733, care of "Plastics." 131-42

For sale, "Transpex" sheets, ¼ in. and 3/16 in.; cellulose acetate rod, ⅜ in.; acetate sheet, 3 mm. clear; P.V.C. strip, ½ in. Box 3363, care of "Plastics." 131-41

SITUATIONS VACANT

None of the vacancies in these columns relates to a man between the ages of 18 and 50, inclusive, or a woman between the ages of 18 and 40, inclusive, unless he or she is excepted from the provisions of the Control of Engagement Order, 1947, or the vacancy is for employment excepted from the provisions of that Order.

Laboratory assistant required for research work dealing with new plastic material developments; applicants should not exceed 20 years and should have intermediate B.Sc., experience in plastics an advantage but not essential. British Nationality, good references. Please write Box 3214, care of "Plastics." 134-3040

A progressive company in the Midlands manufacturing plastic materials requires the services of qualified engineers and mechanical and electrical draughtsmen; applicants for the engineering appointments should be at least of Higher National Certificate standard, all applicants should have some experience of mechanical or chemical plant layout and design, the vacancies offer ample opportunities. Applications, stating previous experience, positions held and academic qualifications, should be sent to Box 3196, care of "Plastics." 132-6033

Experienced manager required to take sole charge of casein material production and plant. Excellent conditions offered to suitable expert. Apply with full details, curriculum vitae, stating salary required. Applications will be dealt with in strictest confidence. Box 3210, care of "Plastics." 131-23

Tanks and Linings, Ltd., require chemist for development and research work for plastics linings and coatings, permanent, progressive job. Full particulars to Tanks and Linings, Ltd., Town Wharf, Hanbury Road, Droitwich. 131-16

Chemist Technologist required immediately for the development of new plastic process. Applicant must be prepared to devote his entire energy to the new project, which offers excellent future possibilities. Opportunity to develop initiative and resource. Apply, stating age, salary and experience, to Box 825, care of Granthams, Advertising Agents, Reading. 131-15

Wanted, salesmen. Must have knowledge of plastic materials. Connection amongst fabricators of thermoplastics of interest, not essential. Apply, letter, giving full particulars of past experience and salary required, to Box 3182, care of "Plastics." 131-12

Established moulding concern seeks representative with sound wholesale connections and experience to take over sales in London area of well-known branded lines. Salary and commission basis. Details of experience and references to Box 3192, care of "Plastics." 131-5

Plastics engineer to undertake development and large-scale production of aircraft structure components, also large unstressed intricate mouldings using low cost moulds, engineering degree preferred, age about 30-40. Home Counties, directorship, important salary. Box 3180, care of "Plastics." zzz-218

Wanted, production manager for new plastic factory in Bombay, must possess sound practical experience in cable production. Apply Box 3151, care of "Plastics." 132-x7207

Situations Vacant (contd.)

Laboratory assistant required for research work on new plastic material developments; applicants should not exceed 18 and must be of British Nationality, experience in plastics an advantage but not essential, good references. Please send particulars of education, etc., to Box 3215, care of "Plastics." 134-3041

Toolroom foreman, fully experienced moulds for plastics, required Coventry. Write Kingston Appointments Bureau, 1 Surbiton Crescent, Kingston-on-Thames. 131-x7780

Chemist (organic), laboratory large works, Birmingham. Work covers testing of paints, plastic materials, controlling paint specifications, development of plastics applications. Preferably graduate with honours degree. State age, experience and qualifications. Box 3344, care of "Plastics." 131-37

Physical chemist required by firm with well-equipped laboratory engaged on active research work chiefly applied to cellulosic and plastic materials. Applicants must have science degree, age about 30, excellent opportunity for the right man. Apply in writing, stating salary required, to Kalamazoo, Ltd., Northfield, Birmingham, 31. 131-35

Wanted, designer-draughtsman experienced design and production injection, compression, transfer and die-casting moulds, progressive position and good salary right man. Send full particulars Box 3346, care of "Plastics." 131-34

Chemist, physical chemist or physicist required for research laboratory engaged in new plastic material development; applicants should have B.Sc., be of British Nationality and not above 25 years, good references essential, salary according to age, qualifications and experience. Please apply Box 3213, care of "Plastics." 134-3039

Works manager required to initiate and run factory producing phenolic resins and moulding powders, must have experience in this field, factory situated Manchester area, bonus on production will be offered. Write, giving details of salary required, experience and availability. Box 3362, care of "Plastics." 131-45

Draughtsman wanted by progressive plastics company in the London area, must have knowledge of the design and detail of tools, jigs and fixtures, preferably with toolroom experience. Experience of plastic mould design an advantage. Apply in writing to Lacrinoid Products, Ltd., Gidea Park Works, Essex, giving details of experience and salary required. 131-26

SITUATIONS WANTED

Man desires change, good knowledge synthetic resins, moulding, powders, varnishes, cements; 20 years' practical experience. Write, Box 3187, care of "Plastics." 131-6

TIME RECORDERS

Factory time recorders. Service rental. Phone, Hop 2239. Time Recorder Supply and Maintenance Co., 157-159 Borough High Street, S.E.1. 137-3686

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Film spools for roll films required in 50,000 lots; also hire of moulding tools. S.L.P.P., 28 Upper Green East, Mitcham. Phone, Mitcham 4296. 131-x4912

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Plastic cement for use with Perspex Acrylic sheets. Grade I, available in large or small quantities, clear and coloured. Trade inquiries from Evolite Plastics, Ltd., 325 Latimer Road, London, W.10. Phone, Lad 1879. 1138-04011

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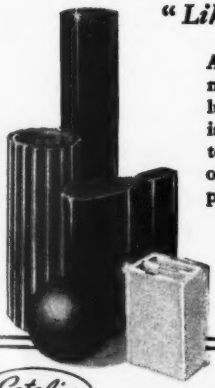

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